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New and revised descriptions of the immature stages of some butterflies in Sri Lanka and their larval food plants (Lepidoptera: Lycaenidae). Part 1: Polyommatinae and Theclinae, in part.

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Abstract. The immature stages of 24 of the 84 species of butterflies of the family Lycaenidae (Polyommatinae and Theclinae, in part) in Sri Lanka are described. The immature stages of 11 species are reported for the first time (including 4 endemic species, 2 endemic subspecies, plus 2 species and 1 subspecies restricted to Sri Lanka and India). Larval food plants of 23 species in Sri Lanka are documented for the first time while for 6 species larval food plants previously reported in Sri Lanka are confirmed. The immature stages of 7 species that have been previously described from Sri Lankan material and 5 species described from Indian material are compared to the findings of the current study and additional observations are presented. This study provides basic information for further studies on the biology of these species which will also be relevant for conservation of butterflies in Sri Lanka.

Keywords: Immature stages, larval food plants, ant association, Sri Lanka, Ceylon, Lycaenidae, Polyommatinae, Theclinae, butterflies, conservation.

Introduction

A comparison of the latest National Red List data (van der Poorten, 2012) on the butterfly fauna of Sri Lanka to historical records (e.g. Ormiston, 1924; Woodhouse, 1949) suggests that the populations of many of the 245 species known in the country have declined. The National Red List 2012 lists 21 species as CR (critically endangered), 38 as EN (endangered), 40 as VU (vulnerable), 20 as NT (near threatened) and 6 as DD (data deficient). As with many other countries, the loss of habitats along with larval food plants seems to be the main cause for these declines.

To address these declines, the Biodiversity Secretariat of the Ministry of Environment of Sri Lanka is developing a Butterfly Conservation Action Plan. However, in order to assess the status of a butterfly species and to prepare conservation management plans, information on the bionomics of the species including the larval food plants and the resource needs of the adults as well as of the immature stages is a prerequisite.

However, the immature stages and larval food plants of the butterflies in Sri Lanka are incompletely known. Woodhouse (1949) published information on the immature stages and larval food plants of 191 of the 242 species of butterflies in the island known at that time. Of these descriptions, 80 were based on work done in Sri Lanka and 111 were based on work done in peninsular India. Little research has been published since then (but see van der Poorten & van der Poorten, 2011).

Knowledge of immature stages and larval food plants, as well as being important for conservation of butterflies, is also useful in classification, elucidating broad-scale evolutionary patterns, understanding ecology at the community and population levels, and in ecological chemistry (DeVries, 1986 and references therein). Knowledge of the immature stages is also important at a more practical level since it enables the identification of larvae and pupae in the field, which can increase the accuracy of surveys even in the absence of adults. Additionally this knowledge is valuable in aiding the development of ecotourism (e.g. establishment of butterfly parks,

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butterfly watching) which is an important economic activity for a country such as Sri Lanka.

In the current study (conducted from 2004 to the present and ongoing), we have documented the immature stages and larval food plants of 176 of the 245 known species of butterflies in Sri Lanka. For more details on the background and approach, see van der Poorten & van der Poorten (2011).

There are 84 species in the family Lycaenidae in Sri Lanka in 4 subfamilies – Curetinae (1 species), Miletinae (1 species), Polyommatinae (1 tribe, 48 species), and Theclinae (11 tribes, 34 species). In this paper, we present the immature stages and larval food plants in Sri Lanka of 15 of the 48 species of Polyommatinae (8 for the first time; genera *Chilades, Jamides, Nacaduba, Prosotas* and *Tarucus*) and 8 of the 34 species of Theclinae (3 for the first time; genera *Arhopala, Surendra, Hypolycaena, Pratapa* and *Tajuria*). Other Lycaenidae will be discussed in subsequent papers.

The immature stages of 7 species covered here have been previously described from Sri Lankan material though most of the descriptions are very brief and only refer to the final larval instar and the pupa. An additional 5 species (not necessarily the same subspecies) have been described from India. These older descriptions are compared to the findings of the current study and additional observations are presented.

For 23 species, new larval food plants are reported for the first time (and additionally for one species for which there is no description available of the larva or pupa), while for 6 species larval food plants previously reported in Sri Lanka are confirmed.

For the majority of lycaenid species worldwide whose life histories have been recorded, ant-larval associations ('myrmecophily') are documented. These associations may be mutualistic or parasitic, and facultative or obligate. Some species of Lycaenids associate loosely with several species of ants (facultative myrmecophiles) while others are more closely tied to an association with only one or perhaps two ant species (obligate myrmecophiles) (Fiedler, 1991; Pierce *et al.*, 2002).

Materials and methods

For rearing methods, see van der Poorten & van der Poorten (2011). Plants were identified to species if possible, using several references (most notably, the series edited by Dassanayake (1980-1998)) and an inspection of herbarium specimens at the Herbarium of the Royal Botanic Garden in Peradeniya, Sri Lanka. No voucher specimens were deposited. Nomenclature of butterflies follows K. Kunte (pers. comm.).

Where information on the duration of developmental stages is given, these data were obtained in rearings at ambient temperatures (22–34°C) at Bandarakoswatte (07.37.01N, 80.10.57E), 70 m asl, North Western Province, Sri Lanka. Conventions used (applied to both the larva and the pupa): Segments are numbered S1 to S14 (S1—the head; S2 to S4—the 3 segments of the thorax; S5 to S14—the 10 segments of the abdomen). In the photographs, the head is always on the left.

Results and discussion

Subfamily: Polyommatinae

Chilades parrhasius nila Evans, 1925. Small Cupid. Endemic subspecies.

In the current study, the immature stages of *C. parrhasius nila* in Sri Lanka are described and the larval food plant identified for the first time.

Notes on immature stages: Egg: dome-shaped, micropyle region depressed to form a concavity, fine surface protuberances forming hexagonal areas (Fig. 1a). 1st instar: head black, body pale yellowish-green. 2nd: not recorded. 3rd (Fig. 1b) & 4th (Fig. 1c): same as 5th. 5th: head black, ground color of body variable from 3rd–5th instars ranging from light green to dark red (each individual can change color from one instar to the next; color seems to be associated with the color of the leaves they eat (red or green)), dorsal band dark green to almost red (in some individuals both colors are present), subtended by a white band; white lateral, supraspiracular and dorso-ventral bands; yellow, brown or reddish between each set of white bands; S2 with depressed area dorsally; entire larva with numerous setae giving it a fuzzy appearance, S11 with dorsal nectar organ (DNO), S12 with a pair of eversible tentacles (TOs); banding highly variable (some lines may be absent or obscure) (Figs. 1d–f). In the field, larvae were attended by ants (species not identified) but they developed normally in the lab without them. Pupa: very similar to that of *C. pandava lanka* but more rounded; ground color variable from pale brownish-green to pale pinkish-green to pale yellow; some with darker brown bands with numerous small markings along the wing buds; abdomen mottled with dark brown and with three lines – a black dorsal discontinuous line and a lateral blotchy line; extent and color of markings variable. In the lab, larvae pupated among leaves (Figs. 1g–i). A dipteran parasitoid (species not identified) emerged from one pupa (Fig. 1j). Length (mm): prepupation (10); pupa (6–8). Duration of immature stages (days):

pupa (6–7); egg to emergence of adult (29–30). The immature stages illustrated by Bhakare (2012) of *C. p. parrhasius* in India are similar except that the pupa is whiter and less spotted.

Larval food plant: The current study showed that *Acacia eburnea* (H. D. Jayasinghe, pers. comm.) and *A. leucophloea* (Fabaceae: Mimosoideae) are larval food plants in Sri Lanka. The larva feeds only on tender leaves. *Acacia* has been reported for *C. p. parrhasuius* in India (K. Kunte, pers. comm.) and additionally *Prosopis* in Saudi Arabia (Larsen, 1983).

C. parrhasius nila is found only in the arid and dry zones. *A. eburnea* is found only in the arid zone where it is very common; *A. leucophloea* is common in the arid, dry and intermediate zones (Dassanayake, 1980). At Yala National Park in the southeast, *C. parrhasius nila* feeds mostly on *A. eburnea* since *A. leucophloea* is uncommon there. In the arid zone of the northwest and the dry zone of the north, *C. parrhasius nila* commonly uses *A. leucophloea*. The distribution of these two larval food plants matches that of the butterfly in that at least one of these two larval food plants has been found wherever the butterfly has been recorded.

Chilades lajus lajus (Stoll, 1780). Lime Blue.

The immature stages of *C. l. lajus* in Sri Lanka have not been described. In India, de Nicéville (1890) briefly described the final instar larva and pupa of *C. lajus*. The findings of the current study agree with this description except that in the pupa, the ground color is highly variable (pale green to dark green) and the markings are variable (almost none to heavily blotched) (Figs. 2a–d). The final instar and pupa look similar to those illustrated in Igarashi & Fukuda (2000) from Bhutan (subspecies not identified).

Additional notes on immature stages: 4th instar (Fig. 2e): same as 5th (Fig. 2f). A DNO and TOs were noted in the 4th & 5th instars. The larvae were often gregarious and were found feeding in twos and threes. The larva was almost always attended in the field by ants (species not identified) but this was not obligatory; the larvae developed normally in the lab without ants. Duration of immature stages (days): pupa (5).

Larval food plant: In Sri Lanka, de Nicéville & Manders (1899) reported that the larva fed on *Citrus* and Woodhouse (1949) reported, without a reference, that it fed on "Rutaceae, *Limonia acidissima*, and various species of *Citrus*." The current study showed for the first time that *Atalantia ceylanica* (S. Sanjeeva, pers. comm.), *Atalantia monophylla*, *Citrus aurantifolia* and *C. sinensis* are used as larval food plants in Sri Lanka and confirmed the use of *Limonia acidissima* (all Rutaceae). de Nicéville (1890) also reported species of *Citrus* as larval food plants in India, and Igarashi

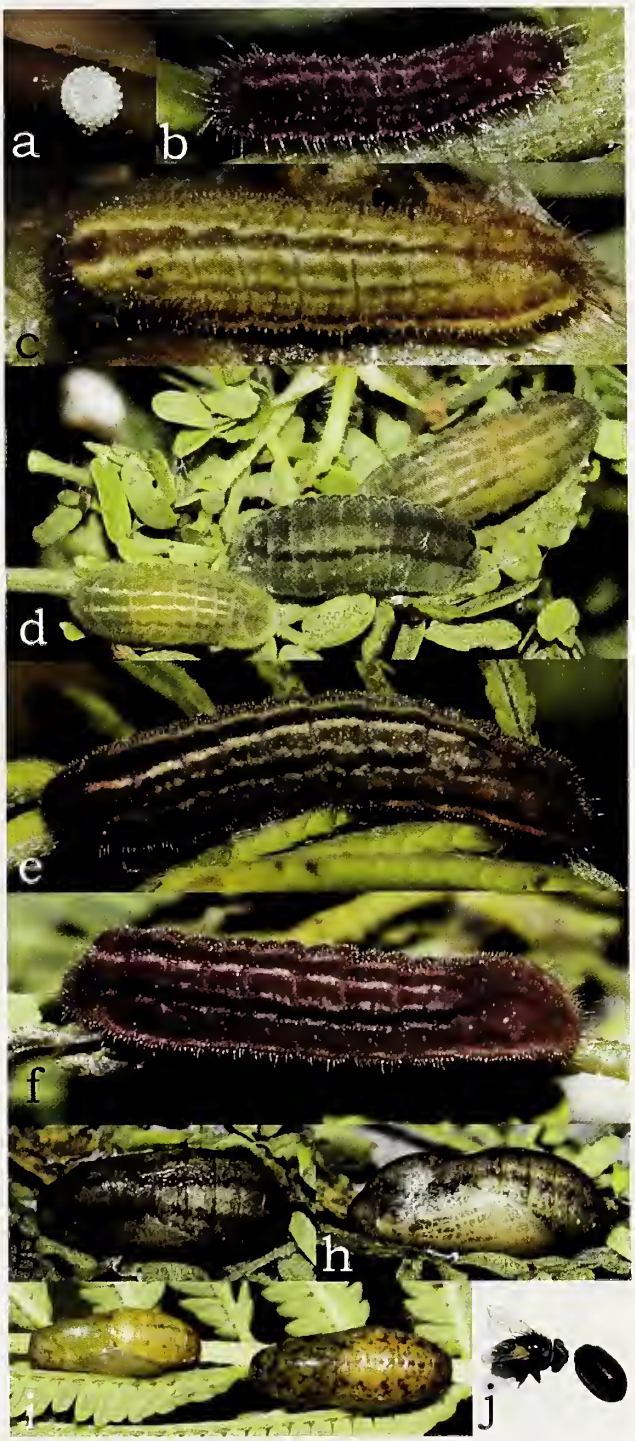

Figure 1. *Chilades parrhasius nila*. **a**. Egg. **b**. Larva, third instar, red form. **c**. Larva, fourth instar, green form. **d**. Larvae, fifth instar, green, dark green & red forms, green & red forms. **e**. Larva, fifth instar, dark red form. **f**. Larva, fifth instar, red form. **g**. Pupa, pale brownish-green form, dorso-lateral view. **h**. Pupa, pale brownish-green form, lateral view. **i**. Pupae, pale yellow form and pale pinkish-green form. **j**. Dipteran parasite with its pupal case

Figure 2. *Chilades lajus lajus*. **a**. Pupa, dark green form, heavily marked. **b**. Pupa, pale green form, lightly marked. **c**. Pupa, light green form, dorsal view. **d**. Pupa, as in (c), dorso-lateral view. **e**. Larva, fourth instar, attended by ants, lateral view. **f**. Larva, fifth instar, dorsal view

& Fukuda (2000) recorded members of the Rutaceae in India, Bhutan and Taiwan. Robinson *et al.* (2010) also lists Anacardiaceae and Tiliaceae from India but we have not been able to review these references. The early instar of the larva feeds on tender leaves; later instars feed on maturing leaves but not fully mature leaves.

Ch. l. lajus is widely distributed across the country but is particularly common in the dry and intermediate zones. *Limonia acidissima* is found mainly in the arid, dry and intermediate zones (both wild and cultivated), with some being planted in the wet zone. *Citrus aurantifolia* and *C. sinensis* are widely cultivated in the dry and intermediate zones and less commonly in the wet zone. *Atalantia ceylanica* and *Atalantia monophylla* are small native trees found widely distributed in the lowlands of all climatic zones. Even though at least one of these larval food plants has been found wherever the butterfly has been recorded, it is likely, given its propensity to feed on a wide range of plants, that other species of the family Rutaceae are also used as noted above.

Chilades pandava lanka (Evans, 1925). Plains Cupid. Endemic subspecies.

The final instar larva and pupa of *C. pandava lanka* were illustrated and described briefly by Moore (1880) from Sri Lankan material. In India, the larva and pupa of *C. pandava* were described by Davidson *et al.* (1896), de Nicéville (1890) and Bell (1918a). The findings of the current study agree with these descriptions except for the following: a) the fifth instar larva has two color forms – violet-brown and yellowish-green; other markings are as described by the earlier authors (Fig. 3a); b) the pupa also has an additional color form—violet brown without any green; both color forms are heavily blotched on the dorsal side of the abdomen and head (Figs. 3b–e).

Additional notes on immature stages: Egg: similar to that of *C. parrhasius nila* (Fig. 3f). 1st instar: not recorded. 2nd: head black, body pale brown, distinct brown dorsal band and brown lateral band, a series of white markings on either side of dorsal line, S14 with a black dorsal patch, body covered with minute setae (Fig. 3g). 3rd: similar to 2nd but white markings more distinct and with similar white markings subdorsally and laterally, black patch on S14 absent, S2 with depressed black area dorsally; DNO and TOs visible (Fig. 3h). 4th: similar to the yellowish-green form of the 5th instar (Fig. 3i). The final instar and pupa are similar to those illustrated in Igarashi & Fukuda (2000) from Taiwan (subspecies not indicated) except that the Taiwan larvae appear more orangish overall. All instars were attended in the field by ants (species not identified) but they developed normally in the lab without ants (Figs. 3j, k). In the field, pupation took place at the base of the cataphylls, often underneath the debris of fallen leaves. Some pupae were also attended by ants.

Larval food plant: In Sri Lanka, Moore (1880) quoted from Thwaites who said it fed on "Cycadaceae"; de Nicéville & Manders (1899) reported that it fed on "young fronds of cycads"; and Manders (1904) reported that larvae were collected from "a species of *Cycas* on the [Colombo National] Museum lawn". Igarashi & Fukuda (2000) also reported it feeding on a *Cycas* (*Cy. revoluta* in Taiwan). There are also records of it feeding on members of the Fabaceae (e.g. *Xylia dolabriformis* in India (Bell, 1918a)). The current study showed the precise species identity of locally used larval food plants as *Cycas nathorstii* and *Cy. revoluta* (Cycadaceae). The larva feeds on tender leaves but when this supply runs out, it feeds on the undersurface of maturing leaves leaving the upper epidermis intact. It does not feed on mature leaves. The eggs are laid singly but since they are laid in large numbers on each leaf frond, the new flush of leaves is sometimes completely consumed by a brood. We have not observed it feeding on any Fabaceae.

Ch. pandava lanka is widely distributed in all climatic zones. *Cycas nathorstii* is widely distributed in forested areas of all the climatic zones including Wilpattu National Park, Bibile, Nilgala and Gampaha (Lindström & Hill, 2002; Lindström & Hill, 2007).

Cy. revoluta is a cultivated plant that is widely planted in gardens. The distributions of *Cy. nathorstii* and *Cy. revoluta* fit that of the butterfly in that at least one of these two plants has been found wherever the butterfly has been recorded. Since there is only one other species of *Cycas* in Sri Lanka that is very rare, it is unlikely that the butterfly has another larval food plant.

Jamides bochus bochus (Stoll, 1782). Dark Cerulean.

The egg, first instar and final instar larva of *J. b. bochus* were described by Green (1905) from Sri Lankan material. In India, Davidson *et al.* (1896) briefly described the final instar larva of *J. bochus* and reported that the pupa was indistinguishable from that of *Chilades pandava* while Bell (1918a) described the final instar larva and pupa in detail. The results of the current study agree with Green including the manner of oviposition (eggs are deposited into a frothy mass exuded by the female) (Fig. 4a). They also agree with the descriptions of the final instar by these three authors though color variations were noted: ground color ranges from light green with faint darker green bands to reddish-brown with dark brown lateral and dorsal bands to purplish-brown with similar banding (Figs.4b-d). Though Green said that he did not notice a "dorsal gland" (DNO) on S11, this organ and TOs are visible (Fig. 4e) from at least the 4th instar. The larva is occasionally attended by various species of ants (species not identified). Bell's description of the pupa agrees with the results of this study (Fig. 4f). The larva and pupa illustrated in Igarashi & Fukuda (1997) from Taiwan are also similar.

Additional notes on immature stages: The larvae were occasionally found in very large numbers. In the lab, they developed normally without ants. Duration of immature stages (days): pupation (2); pupa (7–9); egg to emergence of adult (27–30).

Larval food plants: In Sri Lanka, Green (1905) reported that the larvae fed "on the anthers" and "on the flower buds of a species of *Vigna*." Woodhouse (1949) reported "pods of Leguminosae", and that it was "a pest of Boga medelloa (*Tephrosia candida*) when grown for green manure in Ceylon." The current study showed for the first time that the following are larval food plants in Sri Lanka: *Derris scandens*, *D. elliptica*, *Pongamia pinnata*, *Tephrosia vogelii*, *Vigna radiata*, *V. unguiculata*, *Acacia auriculiformis*, *Cajanus cajan*, *Gliricidia sepium*, *Pueraria phaseoloides* and *Pterocarpus indicus* (Fabaceae). The current study confirmed that *Tephrosia candida* (Fabaceae) is a larval food plant in Sri Lanka. The larva feeds on flowers, especially the ovary and anthers, but did not eat tender leaves that we offered. Many species of Fabaceae have been reported as larval food plants of *J. bochus* from other countries as well, e.g. Japan (Igarashi & Fukuda, 1997) and Singapore (Butterfly Circle, 2012).

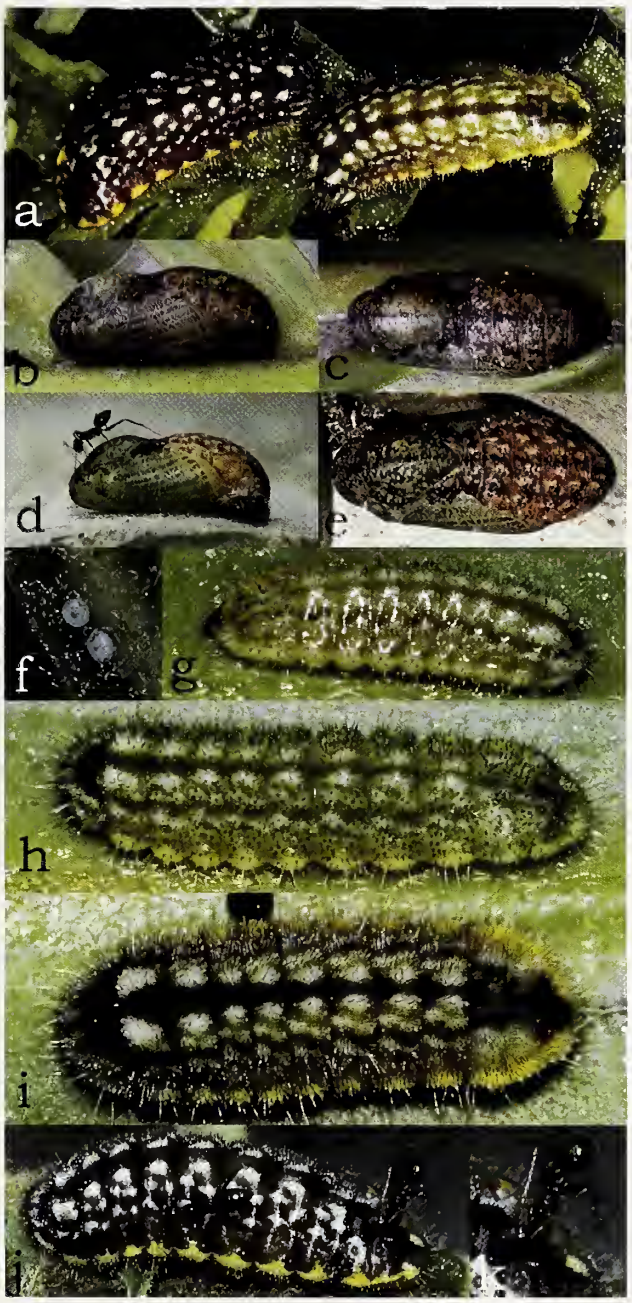

Figure 3. *Chilades pandava lanka*. **a**. Larva, Fifth instar, violet-brown form and yellowish-green form. **b**. Pupa, violet-brown form, lateral view. **c**. Pupa, violet-brown form, dorsal view. **d**. Pupa, green form, lateral view. **e**: Pupa, green form, dorsal view. **f**. Eggs. **g**. Larva, second instar. **h**. Larva, third instar. **i**. Larva, fourth instar. **j**. Larva, attended by ants. **k**. Close up of ant drinking from DNO.

J. b. bochus is common and widespread in Sri Lanka. The native larval food plants (*Derris scandens* and *Pongamia pinnata*) are widely distributed in the dry and intermediate zones and the hills. The other

Figure 4. *Jamides bochus bochus*. **a**. Egg mass. **b**. Larva, final instar, light pink, cream and green form. **c**. Larva, final instar, reddish form. **d**. Larva, final instar, purplish form. **e**. DNO. **f**. Pupa, lateral view

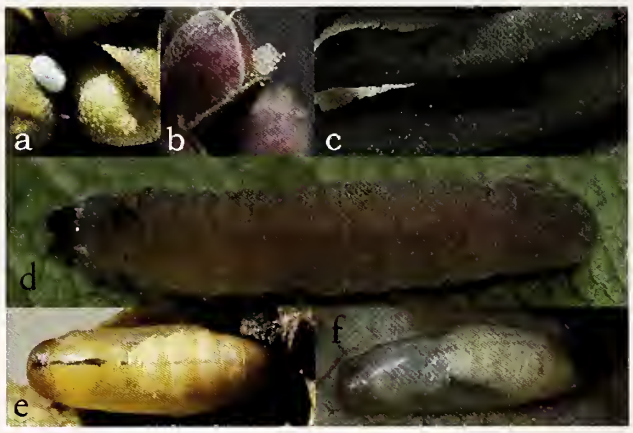

Figure 5. *Jamides coruscans*. **a**. Egg. **b**. Frass at entrance hole of larva. **c**. Larva, third instar. **d**. Larva, final instar. **e**. Pupa, dorsal view. **f**. Pupa, dorso-lateral view.

larval food plants are widely cultivated and *J. b. bochus* is occasionally a pest, particularly of *Cajanus cajan*. *G. sepium*, though an introduced, widely planted exotic, is heavily used in February and March before the onset of the mass migrations of this species. The distributions of the larval food plants reported here fit the distribution of the butterfly in that at least one of these larval food plants has been found wherever the butterfly has been recorded. However, since it is polyphagous, it is likely that other members of the Fabaceae are also used.

Jamides coruscans (Moore, 1877). Ceylon Cerulean. Endemic.

In the current study, the immature stages are described and the larval food plant identified for the first time.

Eggs: laid singly on flower buds or on young shoots when flower buds were unavailable, flattened disc with ridges and a circular depression at the micropyle region (Fig. 5a). 1st instar: the newly hatched larva bored into an unopened flower bud and fed on its contents. It threw its frass out of the entrance hole, leaving signs of its entry (Fig. 5b). It is pale yellowish-pink with a brown head. 2nd: not recorded. 3rd: S2 with a black diamond shaped dorsal patch posteriorly (Fig. 5c). 4th: not recorded. 5th: head brown, mouth parts and the lower half of the face darker brown, body pale brownish-pink with a frosted appearance because of numerous fine setae, faint darker pink dorsal line, spiracles brown, DNO and TOs present (Fig. 5d). Larger larvae exited the flower bud and hid in the inflorescence where it was well-camouflaged. The larva also fed on the very tender leaves of new flushes. All instars were sluggish and later instars hid under the large bracts that envelope the smaller twigs of the tree. Some larvae were accompanied by a small number of ants (species not identified) that were attracted by the DNO. Pupa: pale yellowish-pink to yellowish-brown, sometimes with a dark brown dorsal line on S2–S4 and a faint dorsal line to the end of the abdomen and with a dorsal spot on the last segment (Figs. 5e, f). In the lab, the larva pupated on the underside of a leaf. In the field, pupation presumably occurs on the tree, probably inside the large leaf bracts. Duration of immature stages (days): pupa (12).

Larval food plants: The current study showed that *Humboldtia laurifolia* (Fabaceae) is a larval food plant in Sri Lanka. All instars feed on tender leaves. The early instars also feed on unopened flower buds.

J. coruscans is found in the wet lowlands where it is fairly common along riparian habitats. *H. laurifolia* is an endemic tree that is widely distributed in the wet lowlands (Dassanayake, 1991). Its distribution matches that of *J. coruscans* (i.e. the plant has been found wherever the butterfly has been recorded).

Jamides celeno tissama (Fruhstorfer, 1916). Common Cerulean. Endemic subspecies.

The final instar larva and pupa of *J. celeno tissama* were described briefly by Moore (1880) from Sri Lankan material. In India, the final instar larva and pupa of *J. celeno* (as *Lampides aelianus*) were described by de Nicéville (1890) and Bell (1918a), all later quoted by Woodhouse (1949). The findings of the current study agree with these authors except for the following: a) we encountered only the green form, some with reddish markings (Figs. 6a, b); and b) the pupa is light brown with a tinge of purple (de Nicéville reported pale ochreous green) and it has

Figure 6. *Jamides celeno tissama*. **a**. Larva, final instar, green form, dorsal view. **b**. Larva, final instar, green form with red, dorsal view. **c**. Pupa, dorso-lateral view. **d**. Pupa, dorsal view. **e**. Larvae, third instar with DNO, TOs. **f**. Parasitoid wasp.

black markings (Bell reported brown markings) (Figs. 6c, d). TOs and a DNO were visible from the 3rd instar (Fig. 6e).

Additional notes on immature stages: The larva was sometimes attended in the field by ants (species not identified) but developed normally in the lab without them. When feeding on flowers, it bored into the flower. Larvae were sometimes parasitized by a parasitoid wasp (species not identified) (Fig. 6f).

Larval food plants: In Sri Lanka, Woodhouse (1949) recorded that the larva fed on flowers or young leaves of "*Pongamia glabra* [now *P. pinnata*], *Abrus precatorius*, *Butea frondosa* [now *B. monosperma*], *Saraca indica*". The current study showed for the first time that the following are larval food plants in Sri Lanka: *Vigna unguiculata* and *Pueraria phaseoloides*. The larva feeds on the flowers of these two species. The current study confirmed the use of *Pongamia pinnata* (young leaves) and *Abrus precatorius* (flowers and young leaves). All are species of Fabaceae. We were unable to confirm the use of *B. monosperma* and *S. indica* though both species are present in Sri Lanka. Larval affiliation with various species of Fabaceae is also reported from many other countries, e.g. Taiwan, India and the Philippines (Igarashi & Fukuda, 1997). Veenakumari *et al.* (1997) reported Marantaceae from the Andamans and Nicobar Islands, and Sapindaceae and Meliaceae are also noted in the literature (Eliot 1992).

J. celeno tissama is widely distributed over the island at all elevations. In the lower elevations, *Pongamia pinnata, Abrus precatorius* and *Pueraria phaseoloides* are the most commonly used larval food plants. In the mid-elevations, *Pongamia pinnata* and *Pueraria phaseoloides* are used. The larval food plant in the highest elevations is unknown. It is likely that several other species of Fabaceae or some other family are also used.

Jamides lacteata (de Nicéville, 1895). Milky Cerulean. Endemic.

In the current study, the immature stages (fifth instar larva and pupa) are described and the larval food plant identified for the first time.

Notes on immature stages: Final instar: head black and hidden, body usual lycaenid form, ground color brownish-pink to pink covered with minute black and white setae, posterior end of S2 with black dorsal patch (shaped like a blunt arrowhead), DNO on S11, a pair of subdorsal eversible tentacles on S12, S3–S14 with alternating dark- and light-colored oblique lines, S3–S10 with small dark bluish-gray patches dorsally (each patch studded with black setae) and zigzag lateral banding with a bluish tint, spiracles brown, S11–S14 with dark purplish-brown dorsal patch (Fig. 7a). Pupa: ground color light-pinkish brown, heavily mottled with dark brown and black, head, thorax and abdomen rounded dorsally, black markings confined to the dorsal and subdorsal lines, spiracles white (Figs. 7b, c). We did not observe ants in attendance.

Larval food plant: The current study showed that *Lepisanthes erecta* (Sapindaceae) is a larval food plant in Sri Lanka. The larva feeds only on tender leaves. Although most members of the genus *Jamides* use Zingiberaceae and Fabaceae as larval food plants, *J. lacteata*, like *J. aleuas* in Australia (Braby, 2000), belong to the small minority that use Sapindaceae.

J. lacteata is found in the forests of the intermediate and wet zones below about 800 m asl where it is uncommon. *L. erecta* is uncommon in forests of the moist low country to 1000 m asl (Dassanayake, 1998) and is scattered in the intermediate zone of the southeast. Its distribution appears to match that of

the butterfly. However, since *L. erecta* has not been recorded from all the locations that the butterfly has been recorded, it is possible that there is another larval food plant.

Jamides alecto meilichius (Fruhstorfer, 1916). Metallic Cerulean. Endemic subspecies.

The final instar larva and pupa of *J. alecto meilichius* were described briefly by E. E. Green from Sri Lankan material (quoted in de Nicéville (1890) as *Lampides elpis*). In India, the larva and pupa of *J. alecto* were briefly described by Davidson *et al.* (1896). Woodhouse (1949) quoted from these two sources. The current study agrees with Green's account except for the following points: a) the ground color of the larva is variable and seems to depend on the color of the larval food source – we encountered pale straw-colored larvae and reddish larvae (Figs. 8a, b) but not dull pale green ones; b) in the larva, DNO on S11 and TOs present on S12; and c) most pupae have 2 lateral black spots on S2 at the base of the wings and 2 well-defined subdorsal black spots on S4 just above the wings (Figs. 8c, d).

Additional notes on immature stages: Eggs were laid on the inflorescence of the plant (Fig. 8e). When *Amomum fulviceps* or *A. trichostachyum* is used, most eggs were laid on the top of the inflorescence (which is borne at ground level) since the lower half is frequently covered by fallen leaves. Despite this obstruction, the ♀ navigated through the fallen leaves to lay its eggs successfully, presumably by using olfactory cues. Though many eggs were frequently seen on a single inflorescence, there were never more than two larvae. The larva fed mostly on the large anthers of the flowers by boring into the flower bud; it expelled its frass to the outside (Fig. 8f). Larger buds were preferred, and open flowers were not used despite easy access and visibly large anthers. When the floral bracts were pulled out and the larva exposed, it hurriedly crawled back into the tightly clustered flowers and flower buds to hide. Under field conditions, the droppings were difficult to discern due to the multitude of rotting vegetation around the inflorescences, the frequent rain that washes away the droppings and the very wet conditions around the plant. One specimen in an early instar had white spiracles (Fig. 8g). Pupation occurred within the inflorescence, just inside a bract, with the head pointing up. Duration of immature stages (days): pupa (10–12).

Larval food plants: In Sri Lanka, Green (quoted in de Nicéville, 1890) recorded that the larva fed on the fruit of *Elettaria cardamomum*. The current study showed for the first time that the following are larval food plants in Sri Lanka: *Alpinia purpurata, A. calcarata, Hedychium flavescens, Zingiber zerumbet* and *Z. wightianum* (S. Sanjeeva, pers. comm.), *Z. cylindricum* (H. D. Jayasinghe, pers. comm.) and *Amomum fulviceps* and *A. trichostachyum*. The larva feeds on the flowers and young fruits of these plants. The current study also confirmed the use of the fruits of *Elettaria cardamomum* (S. Sanjeeva, pers. comm.) as a larval food plant. *J. alecto meilichius* does not appear to be a regular pest in cardamom plantations although

Figure 7. *Jamides tacteata*. **a**. Larva, final instar. **b**. Pupa, lateral view. **c**. Pupa, dorsal view

Figure 8. *Jamides alecto meilichius*. **a**. Larva, final instar, pink. **b**. Larva, final instar, straw-colored. **c**. Pupa, dorsolateral view. **d**. Pupa, dorsal view. **e**. Egg. **f**. Larva, hind end projecting from hole in flower bud with frass. **g**. Larva, early instar with white spiracles.

Woodhouse (1949) reported otherwise. All larval food plants are members of the Zingiberaceae. The use of Zingiberaceae by *J. alecto* has been recorded elsewhere as well, e.g. in India, the Andamans and Nicobar Islands or Singapore (Igarashi & Fukuda, 1997; Veenakumari *et al.*, 1997; Tan & Khew, 2012).

J. alecto meilichius is widely distributed but not common within the wet zone forests and wetter areas of the intermediate zone from sea level to about 800 m asl. *Alpinia purpurata, Zingiber zerumbet* and *Elettaria cardamomum* are cultivated plants in the wet zone. The other larval food plants are native plants that are found in the forests of the intermediate and wet zones (Dassanayake, 1983). Though the distribution

of the known larval food plants matches that of *J. alecto meilichius* in that at least one of these larval food plants has been found wherever the butterfly has been recorded, it is very likely that other species of Zingiberaceae are also used.

Nacaduba hermus sidoma Fruhstorfer, 1916. Pale Four Lineblue.

The immature stages and larval food plant of *N. hermus sidoma* have not been described in Sri Lanka or in India, the only two countries in which this subspecies occurs. In the current study, the immature stages (fifth instar and pupa) are described and the larval food plant identified for the first time.

Notes on immature stages: Final instar: head light brown, ground color greenish-white to pink, pink forms with greenish-white hue on S5–S10 and faint dorsal line of a darker pink from S3–S11, posterior end of S2 with rhomboidal shaped dorsal patch which is whitish on the pink form and green on the green form, segments deeply furrowed and clearly marked except S11–S14, DNO on S11, pair of eversible tentacles on S12, anterior edge of S5–S10 with darker, slightly depressed dorsal spot (Figs. 9a–d). Ants (species not identified) were seen feeding on the DNO of the larva but in the lab, the larva developed normally without them. Pupa: light brown to reddish brown, heavily speckled with small black markings, speckling heavier on dorsal line, a large black subdorsal mark on S4 –S5, similar patch on S2, spiracles pinkish or white (Figs. 9e, f).

Larval food plant: The current study showed that *Symplocos cochinchinensis* (Symplocaceae) is a larval food plant in Sri Lanka. The larva feeds only on tender leaves. *N. hermus swatipa* in Koh Samui Island (Thailand) has been recorded feeding on the flowers of *Embelia subcoriacea* (Myrsinaceae), *Nephelium lappaceum* (Sapindaceae) and *Waltheria indica* (Sterculiaceae) (Day, 2012).

N. hermus sidoma is a seasonally common species of the wet zone. *Symplocos cochinchinensis* is a common shrub or tree found mostly in the wet zone from sea level to 2100 m asl (Dassanayake, 1981b). The distribution of *S. cochinchinensis* matches that of *N. hermus sidoma* in that the plant is found wherever the butterfly has been recorded but there are many other species of *Symplocos* growing alongside *S. cochinchinensis* and it is likely that some of these species may also be used.

Nacaduba sinhala Ormiston, 1924. Pale Ceylon Six Lineblue. Endemic.

In the current study, the immature stages are described and the larval food plant identified for the first time. There has been some confusion over the identity of this species. Woodhouse (1949) equated it with *N. atrata* Moore and quoted the description of the larva and pupa from Davidson *et al.* (1896) and Bell (1918b). He further listed the larval food plants as "*Embelia robusta*, *E. ribes* and *Ardisia humilis*" without any reference, though he apparently quoted from Bell (1918b) reporting on *N. atrata* [now *N. beroe*]. Neither description nor larval food plant applies to *N. sinhala*.

Notes on immature stages: 3rd instar: similar to final instar but more slender, white markings less apparent, S5–S12 with white dorsal spot. Final instar: ground color pale to bright reddish-pink, S11 with

Figure 9. *Nacaduba hermus sidoma*. **a**. Larva, final instar, pink form, lateral view. **b**. Larva, final instar, pink form, dorsal view. **c**. Larva, final instar, green form. **d**. Larva, final instar, light pink form. **e**. Pupa, lateral view. **f**. Pupa, dorsal view.

Figure 10. *Nacaduba sinhala*. **a**. Larva, final instar, with ant, dorsal view. **b**. Larva, final instar, dorso-lateral view. **c**. Pupa, dorsal view.

DNO, S12 with eversible tentacles, S1–S11 clearly demarcated, S12–S14 obscurely demarcated, S3–S10 with whitish or yellowish subdorsal band, similar band along the spiracular line, body covered with minute setae which give it a frosted appearance, spiracles white, S3–S10 with slight transverse furrow in middle, posterior margin of S2 with a light pink diamond shaped dorsal spot, S11–S14 with dark purplish tinge. In the field, the larva was attended by ants (species not identified) but in the lab it developed normally without them (Figs. 10a, b). Pupa: dark reddish brown speckled with black, 2 large black rhomboidal subdorsal marks on S4 and S5 bordering the wing, similar black patches at base of wings (Fig. 10c).

Larval food plant: The current study showed that *Dimocarpus longan* (Sapindaceae) is a larval food plant in Sri Lanka. The larva feeds only on tender leaves. There are no records of the larva feeding on the cultivated form of *D. longan*.

N. sinhala is common in the intermediate zone and the Uva province. *Dimocarpus longan* is common in forests of the dry, intermediate and wet zones from sea level to 700 m asl (Dassanayake, 1998). Its distribution matches that of *N. sinhala* in that the plant has been found wherever the butterfly has been recorded and it is likely that it is the only larval food plant.

Nacaduba berenice ormistoni Toxopeus, 1927. Rounded Six Lineblue.

The immature stages and larval food plant of *N. berenice ormistoni* in Sri Lanka have not been described. In India, the larva and pupa of *N. plumbeomicans* were described briefly by Davidson *et al.* (1986) and in detail by Bell (1918b) though it is not clear if these descriptions refer to *N. berenice ormistoni* which is also found in India in the Western Ghats. In the current study, the immature stages are described and the larval food plant identified for the first time.

Notes on immature stages: Final instar: ground color pink to various shades of light green, S3–S11 with 2-3 oblique rather indistinct white lateral lines, head pale brown, dorsal line darker but similar to ground color, S11 with DNO, S12 with a pair of eversible tentacles, body covered with fine white setae but in the green form, some individuals have dark brown setae (Figs. 11a–f). Pupa: head and thorax pinkish-brown, wings yellowish-brown, abdomen light pink, entire body heavily speckled with black, markings on dorsum form an irregular black line, S4–S5 with two distinct subdorsal black patches and one at wing base, spiracles black, some individuals lighter colored (Figs. 11g–i).

Larval food plant: The current study showed that *Lepisanthes tetraphylla* (Sapindaceae) is a larval food plant in Sri Lanka. The larva feeds on tender leaves, flowers and flower buds. In other countries, *N. berenice* is recorded as feeding on a wide variety of plants. For example, Braby (2000) reported the families Proteaceae, Ulmaceae and Sapindaceae while Parsons (1999) additionally reported Fabaceae-Mimosoideae.

N. berenice ormistoni is not commonly reported in Sri Lanka but is widely distributed in the wet and intermediate zones—current reports include Matara, Galle, Haldumulla, Deniyaya, Badulla and Bandarakoswatte near Wariyapola. *Lepisanthes tetraphylla* is common in the forests of the dry and intermediate zone but rare in the forests of the wet zone (Dassanayake, 1998). It is possible that *N. berenice ormistoni* feeds on a different plant in the wet zone, possibly *L. erecta*.

The immature stages and larval food plants of the other *Nacaduba* species in Sri Lanka have not yet been described and in the course of this study, immatures have not been found: *N. calauria evansi* Toxopeus, 1927 (Dark Ceylon Six Lineblue), *N. beroe minima* Toxopeus, 1927 (Opaque Six Lineblue, endemic subspecies), *N. ollyetti* Corbet, 1947 (Woodhouse's Four Lineblue, endemic) and *N. pactolus ceylonica* Fruhstorfer, 1916 (Large Four Lineblue, endemic subspecies). The final instar and pupa of *N. kurava prominens* (Moore, 1877) (Transparent Six Lineblue, endemic subspecies) were described by Moore (1880).

Prosotas nora ardates (Moore, [1875]). Common Lineblue.

The final instar larva and pupa of *P. nora ardates* in Sri Lanka has not been described. In India, Bell (1918b) described in detail the larva and pupa of *P. nora* (as *P. ardates*). Note: many earlier authors confused *P. noreia*, *P. nora* and *P. dubiosa*—it was commonly thought that *P. nora/ardates* had tailed and tailless forms and that *P. noreia* was the tailless form of *P. nora* (as *P. ardates*). It is now established that the tailed form is *P. nora ardates*; the tailless form that closely resembles *P. nora ardates* is *P. dubiosa indica*; and the other tailless form is *P. noreia* (easily distinguished by the white cilia at the apex of the forewing and by the basal band on the underside of the forewing being confined to the cell) (Wynter-Blyth, 1957). The results of the current study agree with the descriptions by Bell (1918a) except for the following: a) in the larva, on the posterior end of S2 there is a whitish dorsal patch, and the ground color is much more variable and ranges from light green to green to greenish-red to reddish-pink, the dorsal line is usually red but can be green, or red and green (Figs. 12a–e); one larva was almost entirely

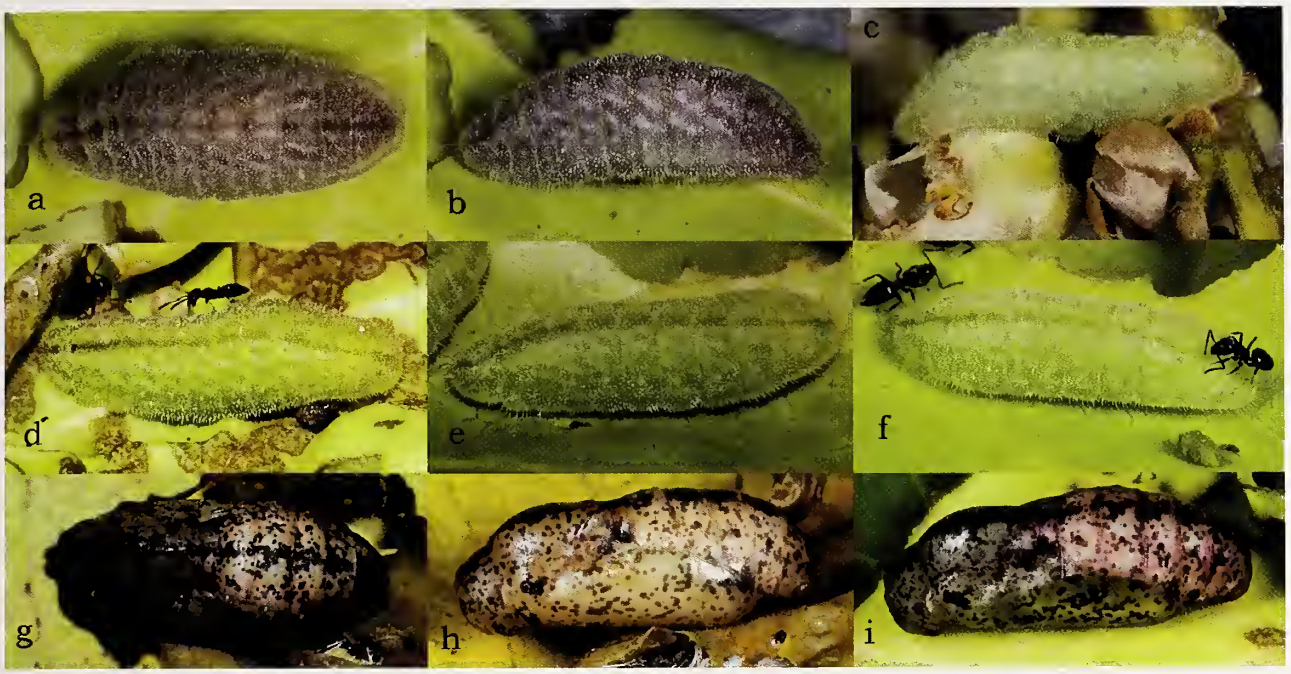

Figure 11. *Nacaduba berenice ormistoni*. **a**. Larva, final instar, pink form, dorsal view. **b**. Larva, final instar, pink form, dorsolateral view. **c**. Larva, final instar, pale green form, feeding on flowers. **d**. Larva, final instar, green form with brown setae. **e**. Larva, final instar, green form with white setae. **f**. Larva, final instar, green form, with ants. **g**. Pupa, dark form. **h**. Pupa, light pink form. **i**. Pupa, pink form.

pale whitish-green with only a red interrupted dorsal line (Fig. 12f); DNO and TOs noted; b) in the pupa, only the abdomen is pinkish-brown—the head, thorax and wings are light greenish-brown and heavily speckled with dark markings (Figs. 12g, h) but in some pupae, the dorsum of the thorax is also pinkish-brown (Fig. 12i).

Additional notes on immature stages: In the field, the larvae were sometimes attended by ants (species not identified) but in the lab they developed normally without them.

Larval food plant: In Sri Lanka, Green (1912), writing under *Nacaduba ardates*, reported that "The larva of the tailed form has been bred by Mr. J. C. F. Fryer, from the flowers of *Allophyllus* [sic] *cobbe*." The current study showed for the first time that the following are larval food plants in Sri Lanka: *Croton aromaticus* (Euphorbiaceae)(S. Sanjeeva, pers. comm.), *Terminalia catappa* (Combretaceae) (S. Sanjeeva, pers. comm.), *Acacia caesia*, *A. pennata*, *Derris scandens*, *Pithecellobium dulce* and *Samanea saman* (Fabaceae). The larva feeds only on flowers. The current study also confirmed the use of flowers of *Allophylus cobbe* (Sapindaceae).

P. nora ardates is common and widely distributed over the island, in all climatic zones, from sea level to almost 2000 m asl. *Acacia caesia* is a native creeper that is widespread, found mainly in the dry zone but also in the lower elevations of the wet and intermediate zones near water courses. *A. pennata* is a native that is found in the dry and intermediate zones only. *Pithecellobium dulce* is a small tree that has become naturalized in the dry and intermediate zones and is planted in urban landscapes in Colombo and along the southwest coast. *Samanea saman* is a large introduced tree that is widely planted across the country in all climatic zones (except the arid zone) up to about 600 m asl (Dassanayake, 1980). *Allophylus cobbe* is a native shrub that is widespread in all climatic zones though it is more common in the drier areas (Dassanayake, 1998). The distributions of these larval food plants match that of the butterfly except at its highest elevations (e.g. Nuwara Eliya) where it must be using a different larval food plant since none of these plants are found there. Robinson *et al.* (2010) report Myrtaceae, Sapindaceae and Combretaceae from other countries but we have not been able to review these references.

Prosotas dubiosa indica (Evans, [1925]). Tailless Lineblue.

The immature stages and larval food plant of *P. dubiosa indica* in Sri Lanka have not been described. See the note under *P. nora ardates*. In the current study, the final instar larva and pupa are described and the larval

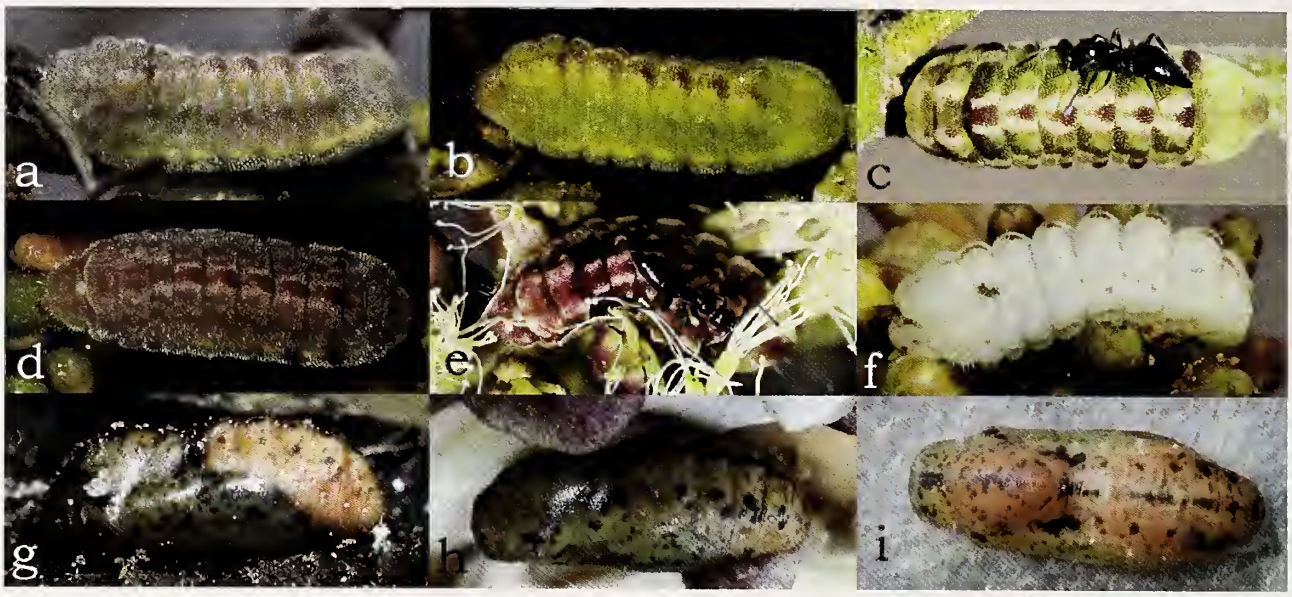

Figure 12. *Prosotas nora ardates*. **a**. Larva, final instar, pale green form. **b**. Larva, final instar, green form. **c**. Larva, final instar, dark green form. **d**. Larva, final instar, reddish form. **e**. Larva, final instar, red form. **f**. Larva, final instar, pale whitish-green form. **g**. Pupa, usual color form, lateral view. **h**. Pupa, usual color form, dorso-lateral view. **i**. Pupa, with pink dorsum of thorax, dorsal view.

food plant identified in Sri Lanka for the first time.

Notes on immature stages: Final instar larva: head light brown, ground color of body pale green, shape same as *P. nora ardates*, dark green dorsal band with minute red markings from S3–S14, diffuse greenish-whitish subdorsal band from S4–S10, broad white dorso-ventral band from S3–S14, spiracles white, DNO and TOs present (Figs. 13a, b). Pupa: shape similar to that of *P. nora ardates*, abdomen and thorax pale brown, head and wings light greenish brown, marked variably with dark brown blotches (Figs. 13c, d). Similar to those illustrated by Igarashi & Fukuda (1997) from Sumatra (subspecies not identified) except that the Sri Lankan larvae are more greenish and the markings more indistinct. Ants were not observed attending any larvae.

Larval food plants: The current study showed that *Samanea saman* and *Albizia odoratissima* (Fabaceae) are larval food plants in Sri Lanka. The larva feeds only on the flowers.

P. dubiosa indica has a slightly more restricted distribution than *P. nora ardates*—it is common in the dry and intermediate zones but less common in the wet zone and ascends the hills to about 800 m asl. *Samanea saman* is a large introduced tree that is widely planted across the country in all climatic zones (except the arid zone) up to about 600 m asl. *Albizia odoratissima* is commonly planted in the dry and intermediate zones and less commonly in wetter areas

Figure 13. *Prosotas dubiosa indica*. **a**. Larva, final instar, dorsal view. **b**. Larva, final instar, lateral view. **c**. Pupa, heavily marked, dorso-lateral view. **d**. Pupa, lightly marked, dorso-lateral view.

(Dassanayake, 1980). Since the distribution of the butterfly is much wider than the distribution of these two plants, there must be other plants used, including native species. Igarashi & Fukuda (1997) reported *P. dubiosa* (subspecies not identified) feeding on *Acacia intsia* (Fabaceae) in Sumatra. Robinson *et al.* (2010) report it additionally feeding in other countries on Proteaceae and Sapindaceae but we have not been able to review the references.

Tarucus nara (Kollar, 1848). Striped Pierrot.

Both *T. nara* and *T. callinara* are found in Sri Lanka and India but their status in these two countries was a source of contention in the past. For instance, Moore (1880), de Nicéville (1890), Bell (1915, 1918a) and Ormiston (1924) believed that the species found in India and Sri Lanka was *T. theophrastus* which is now recognized to occur only in Africa, the Middle East and southern Spain. Bethune-Baker (1918) proved by morphology of the genitalia and androconia that *T. nara* and *T. callinara* were two distinct species and were not the same as *T. theophrastus*. Moore (1880) described and illustrated what he termed '*T. theophrastus*.' The illustration however clearly depicts *T. callinara* though the description is too general and could apply to either *T. nara* or *T. callinara*. He did not list *T. nara*. de Nicéville (1890) thought that all individuals found in India and Sri Lanka were *T. theophrastus* and described its egg, larva and pupa. Despite this claim, he listed and described the adults of *T. nara* and *T. callinara* "...for facility of further study", but listed locations in India for both species. In Sri Lanka, Ormiston (1924) listed only *T. theophrastus* but described two forms and said "I have taken both forms together, and they apparently grade into one another, and I regard them as only seasonal varieties." He seems to have been unaware of Bethune-Baker's article. Woodhouse (1949) listed only *T. nara* which he equated with *T. theophrastus*. He quoted from Ormiston (1924), the description of the larva and pupa from de Nicéville (1890), and the larval food plant from Bell (1915). However, the illustration (Plate 19, #1 & 2) is that of *T. callinara*. d'Abrera (1998) contended that there were two species of *Tarucus* in Sri Lanka: *T. nara* was found in the north and northeast and *T. callinara* in the south and southeast. He wrote that the early stages of *T. nara* were "similar to .... *Castalius rosimon*" and "attended by ants" and that the early stages of *T. callinara* were "not recorded but would undoubtedly confirm specific differences between it and *T. nara*."

According to our new observations, the descriptions of the egg and larva from de Nicéville (1890) and the egg, larva and pupa from Bell (1918a) fit the description of *T. nara* with the following differences: a) in the larva, S2 with a green dorsal patch with brownish hairs, purple supraspiracular spots on S3–S14, some individuals with reddish-purple subdorsal patch on S11–S13 (Figs. 14a–c); b) in the pupa, variable in color and markings—head and thorax light green to brownish green, abdomen cream to brownish-green with varying amounts of black dorsal, subdorsal and lateral spots, spiracles pale pink (Figs. 14d–g).

Additional notes on immature stages: Early instar: similar to final instar but without the red markings on the dorsal line (Fig. 14h). DNO and TOs visible from the 3rd instar. We observed the larvae being attended by ants (species not identified) on only one occasion (Kayts Island, December 2011) (Fig. 14i).

Larval food plants: There are no reports of larval food plants of *T. nara* in Sri Lanka. The current study showed for the first time that *Ziziphus mauritiana* (Rhamnaceae) is a larval food plant in Sri Lanka. In the early instars, the larva feeds on tender leaves but in the later instars it feeds on maturing leaves and seldom on fully matured leaves.

Note: Bell (1915) (quoted in Woodhouse, 1949) writing of *T. theophrastus* said that "the genus of the foodplant seems to be of little importance as long as the ants are there.... [it has been bred] on Rhamnaceae (*Zizyphus* [sic]), and other plants, such as Mistletoe, Jasmine, &c...." This does not appear to be the case in Sri Lanka.

In Sri Lanka, *T. nara* has been currently recorded only in the northern areas of the arid zone—Jaffna, Kayts Island, Mandativu Island, Mannar, Arippu and Murunkan. *Ziziphus mauritiana* is common in the dry and arid zones (Jaffna, Mannar, Puttalam, Trincomalee, Hambantota, Yala) (Dassanayake, 1996) where it is found near the coast, often on the beach. The distribution of *Z. mauritiana* fits the distribution of *T. nara* in that this plant has been found wherever the butterfly has been recorded and it is likely that *T. nara* feeds exclusively on it. It is interesting to note that despite the fact that *Z. mauritiana* has been planted extensively in home gardens and on roadsides near shops in the lowlands of all climatic zones for shade and its fruits, the butterfly has never been observed in these areas. This suggests that rainfall and temperature may be limiting factors in the distribution of the butterfly.

Note: Ormiston was a careful observer of butterflies and his statement (1924) that he has "taken both forms together and they apparently grade into one another" needs to be taken seriously. However, we have not encountered any intermediate forms in the field nor were any seen in the collections at the NHM (London). We have not been able to study Ormiston's collection at the Bombay Natural History Society though it is reported to be in a poor state.

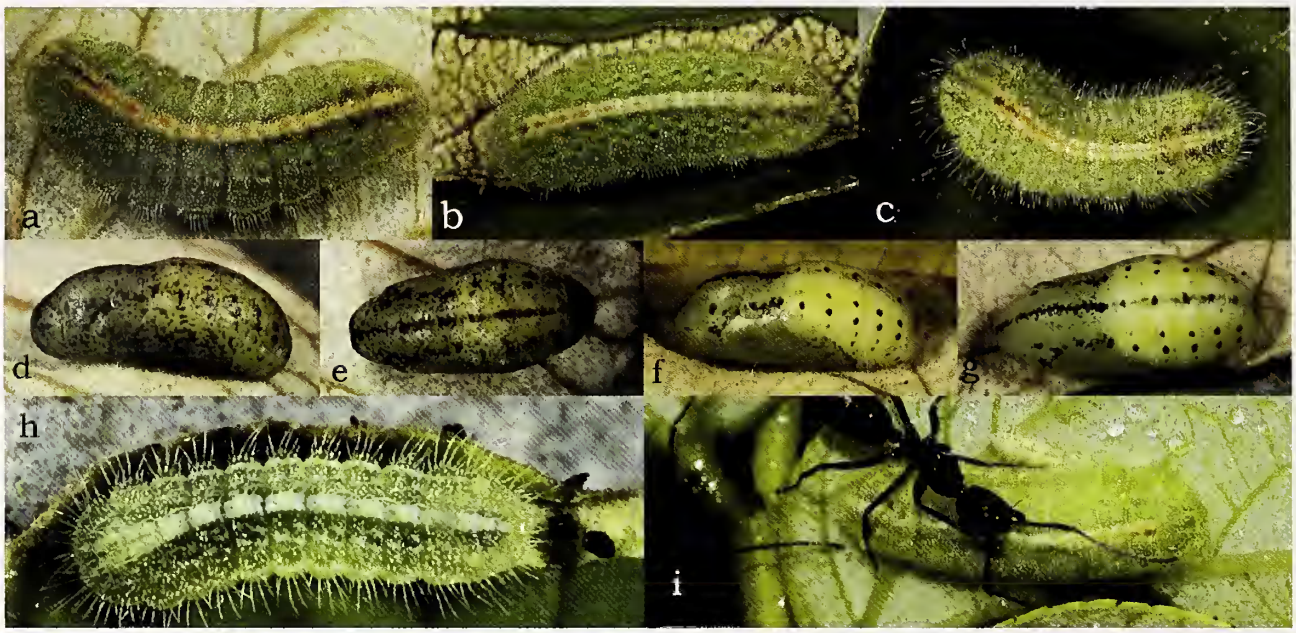

Figure 14. *Tarucus nara*. **a**. Larva, final instar, dorsal line reddish. **b**. Larva, final instar, dorsal line white with red. **c**. Larva, final instar. **d**. Pupa, darker form, lateral view. **e**. Pupa, darker form, dorsal view. **f**. Pupa, lighter form, fewer black markings, dorso-lateral view. **g**. Pupa, lighter form, dorsal view. **h**. Larva, early instar. **i**. Larva, attended by ants.

Tarucus callinara Butler, 1886. Butler's Spotted Pierrot.

See the discussion under *T. nara* regarding the confusion of the genus *Tarucus* in Sri Lanka. In the current study, the final instar larva and pupa are described and the larval food plant identified in Sri Lanka for the first time.

Notes on immature stages: Eggs were laid on the underside of the young leaves of the larval food plant; most were placed a few centimeters off the ground. Larvae and pupae were found on the underside of leaves that were within 12 centimeters of the ground, often overlaid with branches above. The physical barrier thus created and the extremely spiny nature of the larval food plant made it very difficult for birds and lizards to prey upon them. Final instar: body green with a cream-colored dorsal stripe, faint, whitish, short diagonal wavy lines dorso-laterally, dorsal patch on S2 green, entire body covered with numerous setae, those just above the lateral margin much longer; the larva looks less "frosted" than *T. nara* (Fig. 15a). The feeding style of the larva is characteristic—the cells on the underside of the leaf are eaten away in bands leaving the upper epidermis intact; the epidermal cells dry up and break off with time leaving a characteristic pattern on the leaf. No ant/larval associations were observed although a DNO and TOs are present. Pupa: variable in color

Figure 15. *Tarucus callinara*. **a**. Larva, final instar. **b**. Pupa, pale straw-yellow with few markings, dorsal view. **c**. Pupa, same as 10b, lateral view. **d**. Pupa, pale straw-yellow with no markings. **e**. Pupa, light greenish, heavily speckled with black.

and markings; color ranged from pale straw yellow to dark dirty green; some individuals heavily speckled with black, others with only three rows of spots on the abdomen, while others were completely devoid of markings (Figs. 15b–e).

Larval food plants: The current study showed that *Ziziphus mauritiana* (Rhamnaceae) is a larval food plant in Sri Lanka. The larva feeds on tender leaves in the early instars. In the later instars it feeds on maturing leaves but seldom on fully matured leaves. Lab-reared larvae refused a closely allied species, *Ziziphus oenoplia*.

In Sri Lanka, *T. callinara* has been currently recorded only in the southern areas, usually near the coast—Tissamaharama, Hambantota, Kirinde and Yala. *Ziziphus mauritiana* is common in the dry and arid zones (Jaffna, Mannar, Puttalam, Trincomalee, Hambantota, Yala) (Dassanayake, 1996) where it is found near the coast, often on the beach. The distribution of *Z. mauritiana* fits the distribution of *T. callinara* in that this plant has been found wherever the butterfly has been recorded and it is likely that *T. callinara* feeds exclusively on it. It is interesting to note that although its food plant is found in the northern areas, the butterfly is not. Though *T. nara* and *T. callinara* use the same food plant and have similar behaviors and habitat requirements, their distributions appear not to overlap in Sri Lanka. Other species of the genus *Tarucus* have been reported as feeding on *Ziziphus* in India (K. Kunte, pers. comm.) and South Africa (Woodhall, 2005).

Figure 16. *Arhopala centaurus pirama*. **a.** Eversible organs. **b.** Larva, final instar, dorso-lateral view, with ants. **c.** Larva, final instar, dorsal view. **d.** Pupa, lateral view. **e.** Closeup of lateral markings that appear like ant's heads with eyes.

Subfamily: Theclinae
Tribe: Arhopalini

Arhopala centaurus pirama (Moore, 1881). Centaur Oakblue.

The final instar larva and pupa of *A. centaurus pirama* (as *Nilasera pirama*) were described briefly by Moore (1880) from Sri Lankan material. In India, the larva and pupa of *A. centaurus* were described briefly by Davidson & Aitken (1890) and in detail by Bell (1919). The findings of the current study agree with the brief descriptions of the larva given by Moore and Davidson & Aitken except that these descriptions do not describe the larva fully. Davidson and Aitken (1890) stated that they saw no erectile organs on S12 but they are present (Fig. 16a) in Sri Lankan individuals. The detailed description by Bell (1919), however, does not quite fit the Sri Lankan specimens. In Sri Lanka, the final instar larva has ground color light green to white and all specimens studied had the following markings: S3–S4 with a reddish brown lateral marking along the anterior edge; S5–S11 with a reddish-brown oval lateral marking, each with a black spiracle in the center surrounded by a few black setae (posterior to these markings is variably dark to light blackish); S2 with subdorsal and lateral reddish brown stripes that meet posteriorly; S12–S14 indistinctly separated, with a narrow reddish-brown dorsal band, broadest on S14; DNO on S11. Variable characteristics include: S5–S11 with two white wavy lines (the lower one somewhat indistinct) separated by a black or dark reddish-brown band; the dorsum usually brick red but sometimes with diffuse yellow and black markings (Figs. 16b–c). In the current study, the pupa is reddish-brown, wings white with a tint of brown, and head light reddish-brown (Fig. 16d). We have not seen a green pupa (as per Moore,

1881) or a dark brown pupa (as per Bell, 1919).

Additional notes on immature stages: In the field, the 3rd–5th instars and pupa were always attended by ants (*Oecophylla smaragdina*) (this obligatory and species-specific association has been known for a long time, e.g. Davidson & Aitken, 1890) which fiercely guarded their charge but they did well in the lab without them. Observations have not been made for the 1st and 2nd instar. The fifth instar is quite extraordinarily marked. From above, the black spiracle within the reddish-brown spot resembles the head and eyes of a red ant remarkably well—the larva looks like a congregation of red ants and not a larva, thus potentially protecting it from avian or wasp predators (Fig. 16e) but not from parasitoids: many larvae collected in the field were parasitized by two or three different species of braconid wasp (species not identified).

Larval food plants: In Sri Lanka, Moore (1880), quoting from Thwaites, reported *Schleichera trijuga* [now *S. oleosa*]. Woodhouse recorded "Combretaceae, Lythraceae" (but with no reference) and *Terminalia paniculata* (quoting from Davidson *et al.*, 1896, from India). The current study showed that *Syzygium cumini* (Myrtaceae) (H. D. Jayasinghe, pers. comm.), *Lepisanthes tetraphylla* (Sapindaceae) and *Elaeocarpus serratus* (Elaeocarpaceae) are used as larval food plants in Sri Lanka. The larva feeds on tender leaves. *Terminalia paniculata* does not occur in Sri Lanka though other species of *Terminalia* are found here. We have not been able to confirm whether or not *S. oleosa* is used though it is a common plant. *A. centaurus* is highly polyphagous. For example, Igarashi & Fukuda (2000) reported host plants in the families Fagaceae, Combretaceae, Tiliaceae and Lythraceae from various regions in SE Asia. Vane-Wright & Gaonkar (2006) clarified the widespread misuse of the names *A. centaurus* and *A. pseudocentaurus*.

A. centaurus pirama is uncommon and seasonal. It is found in the lower elevations of the wet zone but is more common in the dry and intermediate zones. *Lepisanthes tetraphylla* is common in the forests of the dry and intermediate zones and rare in the wet zone (Dassanayake, 1998). *Elaeocarpus serratus* is common in the forests of the wet and the moist intermediate zones (Dassanayake, 1995). The distribution of the host ant in Sri Lanka has not been systematically studied though it is most common in the dry and intermediate zones, and scarce in the arid and wet zones. Since the larva-ant relationship is obligate, the presence of the ant is a limiting factor as long as an acceptable larval food plant is found. The distributions of these larval food plants match that of the butterfly in that at least one of these plants has been found wherever the butterfly has been recorded though given the high degree of polyphagy recorded for the butterfly, there may be additional larval food plants used, possibly other species of *Lepisanthes* and *Elaeocarpus*.

Arhopala amantes amantes (Hewitson, 1862). Large Oakblue.

The final instar larva and pupa of *A. a. amantes* were described briefly by Moore (1880) presumably from Sri Lankan material. In India, the larva and pupa of *A. amantes* were described briefly by Davidson *et al.* (1897) and in detail by Bell (1919). The findings of the current study agree with these descriptions except for the following: a) the ground color of the final instar larva is pale yellowish-green or reddish-brown and S7–S9 often with an indistinct subdorsal black patch (Figs. 17a–c); and b) the color of the pupa is variable: some have a pale light green thorax, white wings and pale reddish-brown abdomen (darker towards the tip) with spiracles on S9–S11 surrounded by long setae; others have a greenish-grey thorax, wings light brown with dark brown striations between the veins, and abdomen dark reddish-brown with black blotches (Figs. 17d–g). It normally pupates within a leaf.

Additional notes on immature stages: Egg: dome-shaped, flattened at base, honeycombed with fine projections (Fig. 17h). 1st instar: newly hatched—head yellowish-orange, body pale brownish-yellow with a darker lateral band, S10–S11 with a light purplish dorsal blotch, typical lycaenid shape with long setae on the dorso-ventral margin (Fig. 17i). 2nd: pale yellowish-green but shaped as per final instar larva, S3–S10 darker green dorsally, S14 depressed dorsally, setae long and pinkish (Figs. 17j, k). From 2nd to 5th instar, the larva changes color and pattern as it ages within the instar. 3rd: ground color varies depending on the color of the young leaves on which it rested and fed (some trees have pale yellow young leaves; others reddish); body light reddish-brown or yellowish-green, wide brownish-green dorsal band on S3–S10 bordered by a thin greenish-yellow line which extends to S2 and S14, S2 yellow anteriorly, S14 yellow posteriorly, spiracles off-white (Figs. 17l, m). 4th: similar to 3rd (with two color forms) but colors more saturated, dorsal band brownish-green at the center and yellowish-green with diffuse red areas at the edges, yellow line darker, and a light reddish line below this, S2 with a dome-shaped yellow dorsal area (Figs. 17n, o). In the field, the 3rd–5th instar larvae were attended assiduously by red ants (*Oecophylla smaragdina*) which fed from the DNO (Fig. 17p) but they developed normally in the lab without them. Larvae were parasitized by a wasp (Braconidae: species not identified) whose larvae emerged in the fifth instar (Figs. 17q, r). In one instance, a first instar larva that was collected and reared in the lab was parasitized though the parasitic larvae did not appear until the 5th instar. It is possible that the butterfly larva was parasitized during the 1st instar and that the eggs or larvae of the parasite remained dormant until the caterpillar's 5th instar (Seufert & Fiedler, 1999). Duration of immature stages (days): pupa (11); egg to emergence of adult (43).

Larval food plants: Woodhouse (1949) listed "Leguminosae, etc., and where there are red ants' nests. *Hopea, H. jucunda, Lagerstroemia, L. flos-reginae* [now *L. speciosa*], *Terminalia catappa*, etc." but with no source. The current study showed for the first time that the following are larval food plants in Sri Lanka: *Syzygium cumini* (Myrtaceae) and *Terminalia chebula* (Combretaceae). The larva feeds only on tender

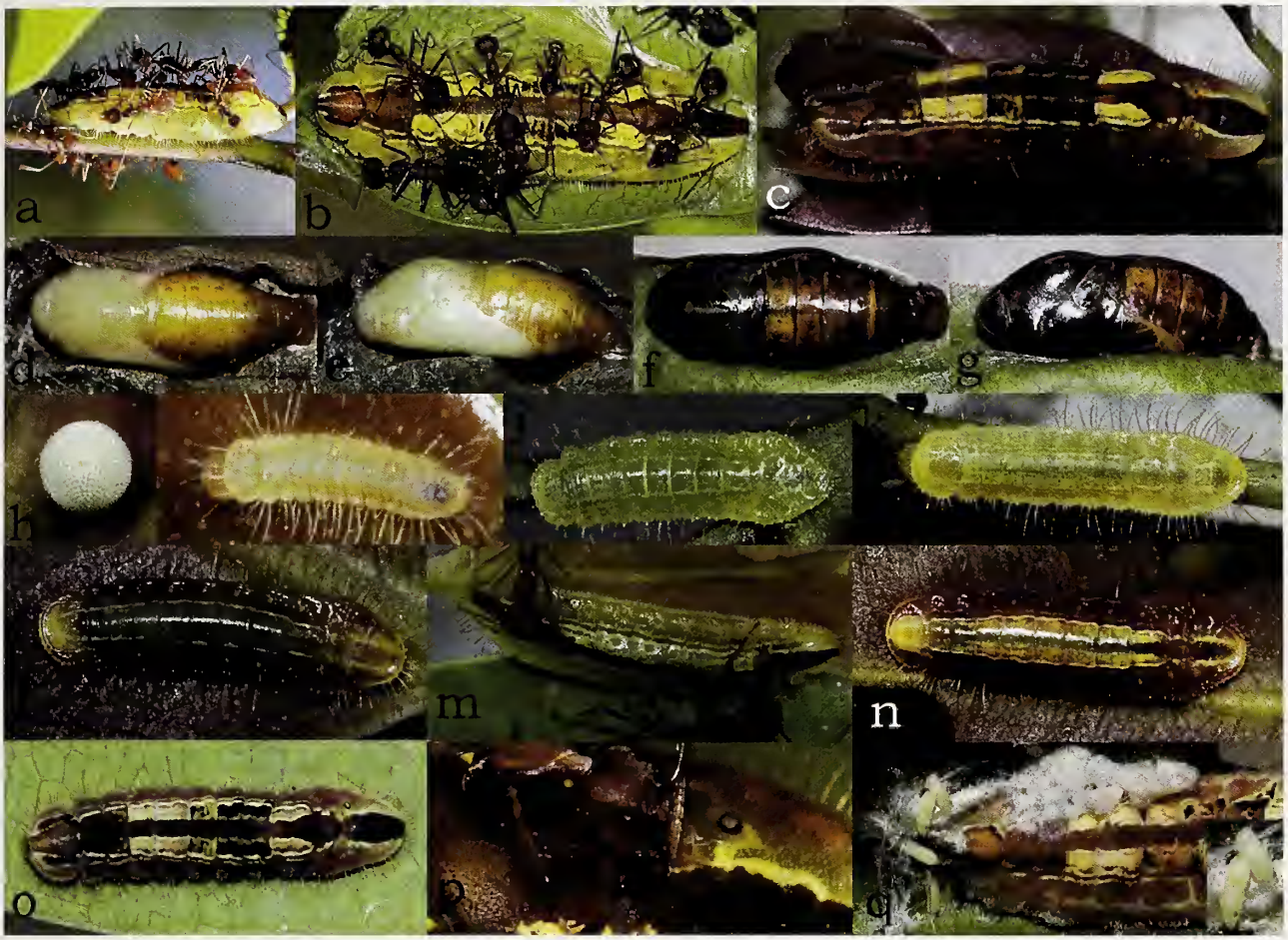

Figure 17: *Arhopala amantes amantes*. **a**. Larva, fifth instar, pale yellowish-green ground color, with ants, lateral view. **b**. Larva, fifth instar, pale yellowish-green ground color, with ants, dorsal view. **c**. Larva, fifth instar, reddish-brown ground color, dorso-lateral view. **d**: Pupa, light colored form, dorsal view. **e**: Pupa, light colored form, lateral view. **f**. Pupa, dark colored form, dorsal view. **g**. Pupa, dark colored form, lateral view. **h**. Egg. **i**. Larva, first instar, head visible, dorsal view. **j**. Larva, early second instar, dorsal view. **k**. Larva, later second instar, head visible, dorsal view. **l**. Larva, early third instar, dorsal view. **m**. Larva, late third instar, with ants, dorsolateral view. **n**. Larva, early fourth instar, dorsal view. **o**. Larva, late fourth instar, dorsal view. **p**. *Oecophylla smaragdina* feeding from DNO on S11. **q**. Parasitized larva with braconid wasp larvae emerging and spinning pupal cocoons. **r**. Close up of braconid wasp larvae.

leaves. We have not been able to confirm the use of *H. jucunda*, *L. speciosa* or *T. catappa* though these plants are found in Sri Lanka.

A. a. amantes is widespread below 300 m asl in all climatic zones. *Syzygium cumini* is widespread in the dry and intermediate zone forests, particularly along streams and tanks (man-made lakes) (Dassanayake, 1981a). *Terminalia chebula* is widespread in the dry and intermediate zones in open savannah and grasslands (Dassanayake, 1995). The larval food plant that is used by the butterfly in the wet zone is not known but is likely to be a species of *Syzygium* or *Terminalia* which have representatives there. *A. amantes* is an obligate myrmecophile and has been reported to be highly polyphagous (a trait usually associated with this condition). For example, Robinson *et al*, (2010) listed Combretaceae, Dipterocarpaceae, Lythraceae, and Leguminosae in other countries, though we have not been able to review these references. The distribution of the host ant will also limit the distribution of the butterfly.

Arhopala ormistoni Riley, 1920. Ormiston's Oakblue. Endemic.

In the current study, the immature stages are described and the larval food plant identified for the first time.

Notes on immature stages: Although oviposition by the ♀ has not been observed in the field, a single 3rd instar larva that was collected on a very young

leaf of the larval food plant at a height of about 2 meters produced an adult male of *A. ormistoni* at emergence. A few ants (species not identified) were found on the larva when it was collected, but it appears to have no obligatory relationship for completing its life cycle successfully. The larva ate voraciously and developed very quickly, presumably to avoid the prospect of having to eat the rapidly maturing leaves that turn tough and unpalatable, and possibly toxic. The larva reared in the lab wandered around before pupation and settled on a dried leaf to pupate. 3rd instar: head pale pinkish-yellow, ground color pale yellowish-brown with red, white and green markings, S2–S10 with red and green interrupted dorsal line, subtended by a white interrupted band, then by a greenish band, then by a white interrupted band, spiracles white with a reddish transverse diffuse band above and below, S2 shield-like with a central dome, DNO on S11 and eversible tentacles on S12, entire body covered with small reddish setae giving a frosted appearance, similar but longer setae on dorso-ventral margin (Fig. 18a). 4th: ground color darker reddish-brown, S2–S14 with continuous green dorsal line, subtended by broad cream-colored band which has light reddish to brownish patches at its borders, spiracles white and surrounded by red markings, S2 with a pair of small red spots anteriorly, center of dome with green triangular mark, edges translucent white, lateral margins as in ground color (Fig. 18b). 5th: ground color pale purplish-green, more or less translucent, S2–S14 dorsal line dark purplish, diffuse pinkish markings on either side from S4–S10, spiracles surrounded by diffuse reddish patches (Fig. 18c). All instars studied were superbly camouflaged amidst the leaves of its larval food plant. Pupa: similar in shape to that of *A. centaurus pirama*, ground color pale brownish-green with light brown and black markings, more extensive on the head and thorax, spiracles white surrounded by beige, series of subdorsal black spots on the abdomen (Figs. 18d, e). Duration of immature stages (days): 4th instar (3); 5th (3); pupa (10).

Larval food plants: The current study showed for the first time that *Vateria copallifera* (Dipterocarpaceae) is a larval food plant in Sri Lanka. The larva feeds only on tender leaves. The use of members of the family Dipterocarpaceae is rare among butterflies but does show up in the Arhopalini (Megens *et al.*, 2005).

A. ormistoni is restricted to lowland dipterocarp forests in the wet zone (Kanneliya, Morapitiya, Sinharaja, Meetirigala) with a disjunct population in a wet zone-like forest at Nilgala in the dry zone. *Vateria copallifera* is widespread and common in the wet zone below 1000 m asl (Dassanayake, 1980) though it has not been recorded from Nilgala. At Nilgala the butterfly was seen near *Vatica obscura* (Dipterocarpaceae), which is perhaps the larval food plant used in that area.

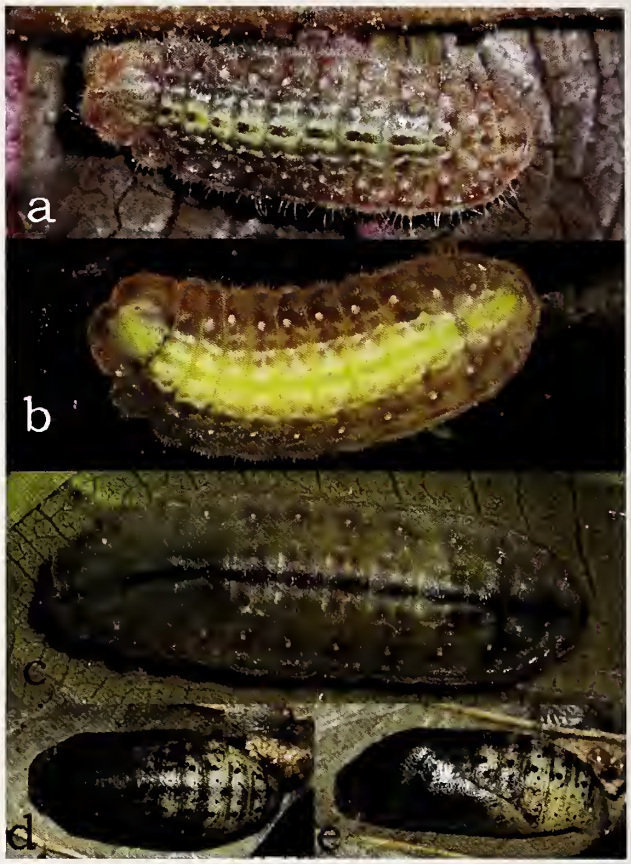

Figure 18. *Arhopala ormistoni*. **a.** Larva, third instar. **b.** Larva, fourth instar. **c.** Larva, fifth instar. **d.** Pupa, dorsal view. **e.** Pupa, dorso-lateral view.

Arhopala abseus mackwoodi (Riley, 1923). Aberrant Bushblue. Endemic subspecies.

The immature stages and larval food plant of *A. abseus mackwoodi* in Sri Lanka have not been described, nor have the immature stages of *A. abseus* in India been described by the usual authors (Bell 1919; Davidson & Aitken 1890; Davidson *et al.*, 1896). Igarashi & Fukuda (1997) illustrated the final instar larva and pupa of *A. abseus* in Thailand (no subspecies identified) but could not identify the larval food plant. In the course of the current study, we have not yet encountered eggs, larvae or pupae though adults have been seen on many occasions at a few locations. However, a larva was found and raised on the tender leaves of *Vateria copallifera* (Dipterocarpaceae), but no description of the larva or pupa is available (H. D. Jayasinghe, pers. comm.).

Surendra quercetorum discalis Moore, 1857. Common Acacia Blue.

The immature stages of *S. quercetorum discalis* in Sri Lanka have not been described. In India, the final instar larva and pupa of *S. quercetorum* were described by Davidson *et al.* (1896) and Bell (1919). Woodhouse (1949) quoted from Bell (1919). The current study agrees with these descriptions with the following exceptions: a) the final instar is more variable than described by Bell (1919) and it has two forms: a green form (similar to that described by Bell 1919 except that some larvae are completely green without any pink and the dorsal band is sometimes absent) (Fig. 19a) and a dark purplish-brown form (Fig. 19b). The markings on the purplish-brown form are similar to those on the green form but the lateral diagonal lines are dark pinkish-brown; b) the pupa has a girdle (Davidson *et al.* reported it was fastened only by the tail though Bell reported the girdle) and the extent of black blotching is variable with some specimens having sparse markings (Figs. 19c, d). A DNO and TOs are visible in the 5th instar.

Additional notes on immature stages: The ♀ sometimes laid 6–10 eggs in a closely spaced group though it usually laid one or two. Some eggs have a pink tinge (Fig. 19e). The egg and larva are almost always attended by ants (species not identified) but the relationship is not obligate as larvae developed normally in the lab without ants. We have not observed eggs or larvae on plants that are without the ants. The ♀ often walked along the branches before oviposition, presumably to verify the presence of ants. Sometimes, ants rushed towards her and either touched or climbed onto the abdomen, perhaps to signal that they were present (Fig. 19f). The final instar larva often forms a shelter by loosely joining several leaves together (Fig. 19g). One specimen of an early instar was entirely green with only faint dorsal markings (Fig. 19h). One larva was found that was parasitized by a dipteran (Fig. 19i). Once the dipteran eclosed, the parasitized larva was then attacked by the ants that previously attended it (Fig. 19j). It appears that the ants benefit whether or not the larva is parasitized, either as a source of sugar or a source of protein. It is unclear what benefit the larva gains from this relationship especially when the ♀ seeks out the ants to lay its eggs. Duration of immature stages (days): pupa (11).

Larval food plants: In Sri Lanka, Woodhouse listed *Acacia caesia* and *A. pennata* after Bell 1915 [sic] (the actual reference is Bell 1919). The current study showed for the first time that *Calliandra surinamensis* (Fabaceae) is a larval food plant in Sri Lanka and confirmed the use of *A. caesia* and *A. pennata* (Fabaceae) as larval food plants in Sri Lanka. The larva feeds only on tender leaves and on the exudates from the extrafloral nectar gland at the base of the leaf (Fig. 19h). The same behavior was noted for the related *S. florimel* from Malaysia (Fiedler, 1992b). Igarashi & Fukuda (2000) reported *S. quercetorum* feeding on *A. catechu* in India, and Veenakumari *et al.* (1997) reported *S. qurcetorum* [sic] *latimargo* feeding on a species of *Acacia* in the Andamans and Nicobar Islands.

Figure 19. *Surendra quercetorum discalis.* **a.** Larva, fifth instar, green form. **b.** Larva, fifth instar, purplish-brown form. **c.** Pupa, lateral view. **d.** Pupa, dorsal view. **e.** Eggs. **f.** Female attended by ant while ovipositing. **g.** Larva, fifth instar, attended by ants within its leaf shelter. **h.** Larva, early instar (entirely green) feeding on gland at the base of the leaf. **i.** Parasitized larva with dipteran pupa case beneath. **j.** Parasitized larva being eaten by its former attendant ants

S. quercetorum discalis is found all over the island in the dry, intermediate and wet zones up to about 800 m asl. *Calliandra surinamensis* is an introduced ornamental that is widely planted in the intermediate and wet zones. *Acacia caesia* is a native that is found in all climatic zones up to about 500 m asl. *A. pennata*

is a native that is found in the dry and intermediate zones only. The distribution of these plants matches that of the butterfly in that at least one of these plants has been recorded wherever the butterfly is found.

Subfamily: Theclinae
Tribe: Hypolycaenini

Hypolycaena nilgirica Moore, [1884]. Nilgiri Tit.

In the current study, the immature stages are described and the larval food plants, which are members of the Orchidaceae, are identified for the first time.

Notes on immature stages: Eggs were laid singly, in large numbers, anywhere on the orchid including the inflorescence and stem for ground orchids, and the aerial roots and flowers for epiphytic orchids (Fig. 20a). Many eggs collected in the field were parasitized by an unidentified parasitoid. 1st instar: newly emerged larva: fed on the buds and flowers of the inflorescence, the stem or aerial roots depending on the species of orchid; head pale brown, body translucent greenish-yellow (sometimes almost white), faint greenish dorsal line, and pink subdorsal line, and between these two lines, two long black setae on each segment, similar set of setae dorso-ventrally, S2 with a hemispherical translucent dorsal depression (Fig. 20b). 2nd: ground color ranges from pale pink to pale green to almost white, otherwise similar to 1st instar except that dorsal line and subdorsal band are red, often with a light pink lateral line; DNO visible (Fig. 20c). 3rd: head brown, body with numerous small setae giving it a frosted appearance, purplish dorsal band, more prominent in anterior segments, faint purplish subdorsal discontinuous line, spiracles black surrounded by purple, dorso-ventral fold commonly edged with a purple band; TOs visible (Fig. 20d). 4th: similar to 3rd (Fig. 20e). 5th: Most larvae with a purplish dorsal line, a thinner, less well-defined white dorso-lateral line, adjacent to this a pinkish line, and a well-defined purplish-pink dorso-ventral margin below the spiracles, but some individuals are devoid of any banding, spiracles distinct and dark brown, body covered with numerous setae giving it a fuzzy frosted appearance, S12 with eversible tentacles (rarely displayed), S11 with DNO (Figs. 20f–h). Some larvae were attended by ants (species not identified) but most were not despite the presence of the DNO. Larvae reared in the lab without any ants developed into normal adults. Coloration of larva seems to match that of its substrate, offering a remarkable degree of crypsis on the variably colored parts of the plant.

Pupation commonly occurred on the plant (on the inflorescence or immediately below it for ground orchids; elsewhere on the plant for epiphytes), with head pointing down and attached to substrate by a very wide cremaster and a girdle. Pupa: well camouflaged, colored less variably than larva, smooth, ground color green with diffuse purplish area on dorsum of thorax, two distinct dark areas just above the wing, spiracles white except that on S2 black, surface often covered with minute white markings (Figs. 20i, j). Some pupae have whitish or pinkish markings along the lower margin of the wing buds (Figs. 20k, l). Duration of immature stages (days): 1st instar (2); 2nd (3–4);

Figure 20. *Hypolycaena nilgirica*. **a.** Egg. **b.** Larva, first instar. **c.** Larva, second instar, intermediate color form. **d.** Larva, third instar, green form. **e.** Larva, fourth instar, pink form. **f.** Larva, fifth instar, green form. **g.** Larva, fifth instar, mixed color form. **h.** Larva, fifth instar, white color form (on white flower). **i.** Pupa, lateral view, on stem of ground orchid. **j.** Pupa, dorsal view, as per (i). **k.** Pupa, lateral view, on aerial root of epiphytic orchid. **l.** Pupa, dorsal view, as per (k).

3rd (3); 4th (4–6); 5th (4-6); pupa (9–11); egg to emergence of adult (25–27).

Larval food plant: The current study showed for the first time that various species of Orchidaceae are used as larval food plants in Sri Lanka including *Malaxis versicolor* (flowers) (H. D. Jayasinghe, pers. comm.), *Peristylus trimenii* (flowers) (H. D. Jayasinghe, pers. comm.), *Vanda* sp. (cultivated) (aerial roots) (P. D. Dissanayake, pers. comm.), *Arundina graminifolia* (flowers and flower buds), *Spathoglottis plicata* (flowers and flower buds), *Arachnis flos-aeris* (aerial roots), *Vanda tessellata* (aerial roots, flowers, flower buds) and *Vanda testacea* (aerial roots). Those feeding on aerial roots prefer the actively growing tips but in the lab fed on the inside of older roots as well. Various species of *Hypolycaena* (in the subgenus *Chliaria*) are also reported to be specialists on the Orchidaceae, e.g. *H. othona* in Malaysia (Fiedler, 1992a) or *H. danis* in Australia (Braby, 2000), though other species like *H. erylus* feed on a wide range of plants (e.g. Veenakumari *et al.*, 1997 in the Andamans and Nicobar Islands).

H. nilgirica was reported as being rare though widespread (Woodhouse, 1949) but current records show it to be more common, at least during its flight season, and more widely distributed. It is found in the dry, intermediate and wet zones up to about 800 m asl. *M. versicolor* is a native ground orchid that is fairly common in shady places in submontane, midcountry, and subtropical montane forests. *H. nilgirica* was observed using this plant in Nilgala which is technically in the dry zone but some of its forest has the character of a wet zone forest. *P. trimenii* is a rare endemic orchid that grows in shade near streams in the eastern intermediate zone. *A. graminifolia* is an introduced ground orchid that has now become naturalized and is well-established in the wild. It occurs near seepages at the bottom of hills and in moist meadows of the wet lowlands and hills. *S. plicata* is an introduced ground orchid, which is more widely grown in home gardens and is much less invasive than *A. graminifolia*; it is found in the wet zone lowlands up to 500 m asl where it is naturalized in some places. *Arachnis flos-aeris* is an introduced epiphyte that is widely cultivated in home gardens in the dry, intermediate and wet zones. *Vanda tessellata* is a native epiphyte that is common on trees in dry and intermediate zone forests and along the east coast. *Vanda testacea* is a native epiphyte that is common on trees along roadsides and in the wet lowlands and the forests of the dry and intermediate zones up to the mid-elevations (Dassanayake, 1981a; Fernando & Ormerod, 2008). *H. nilgirica* successfully exploits exotic orchids, which tend to be more prolific and less seasonal in their flowering behavior, and this has allowed a once rare butterfly to become much commoner. Braby (2000) reported a similar phenomenon in Australia where *H. danis* has become a pest of garden orchids. It is likely that other native and cultivated orchids are also used as larval host plants.

Subfamily: Theclinae
Tribe: Iolaini

Pratapa deva deva (Moore, [1857]). White Royal.

The immature stages of *P. d. deva* in Sri Lanka have not been described. In India, the final instar larva and pupa of *P. deva* were described by Davidson *et al.* (1896) and Bell (1919). In the current study, the final instar and pupa were reared by H. D. Jayasinghe. The descriptions of Davidson *et al.* (1896) and Bell (1919) agree with his results except for the following: a) in the larva, the spiracles are white, ringed with brown (Figs. 21a, b), and b) in the pupa, the wing buds are light purplish-brown and their bases are white (Figs. 21c, d). Bell (1919) reports the presence of a DNO and faint TOs. No ants were observed attending the larva or pupa. The pupa illustrated by Igarashi & Fukuda (1997) from Malaya (no subspecies given) is much whiter overall, agreeing with the description of the Indian specimens.

Larval food plant: In Sri Lanka, Woodhouse listed "*Loranthus tomentosus* [now *Taxillus tomentosus*] and *L. scurrula* [now *Scurrula parasitica*]" after Davidson *et al.* (1896). The current study showed for the first time that *Scurrula cordifolia* is a larval food plant in Sri Lanka (S. Sanjeeva, pers. comm.) and confirmed the use of *Taxillus tomentosus* (Loranthaceae) (H. D. Jayasinghe, pers. comm.). The restriction to members of the family Loranthaceae has been recorded in the whole region (e.g. Igarashi & Fukuda, 1997; Veenakumari *et al.*, 1997).

P. d. deva has been reported only from the Uva province in the southeast of the island. *Scurrula cordifolia* is found scattered in the dry and intermediate zones while *Taxillus tomentosus* is common in the Uva basin and scattered in the intermediate zone (Dassanayake, 1987). The distribution of these two species matches the distribution of the butterfly in that at least one of these plants has been found where the butterfly has been recorded and it is unlikely that there is another larval food plant.

Tajuria jehana ceylanica Riley, 1921. Plains Blue Royal. Endemic subspecies.

The immature stages and larval food plant of *T. jehana ceylanica* have not been described, nor have those of *T. j. jehana* in India. In the current study, the immature stages are described and the larval food plant identified for the first time.

Notes on immature stages: Egg: white, dome-shape with honeycombed ridges, laid anywhere on the larval food plant (Fig. 22a). 1st instar: newly emerged larva with head black, body pale yellow, S2 with depressed black dorsal patch and 2 pairs of large black setae that point forward, S3–S10 dark reddish-brown dorsal band, often discontinuous and with black setae and orangish-yellow discontinuous band laterally and subdorsally, S11–S12 light gray dorsally (Fig. 22b); 2nd: shaped as per the final instar (described in detail for *T. cippus* by Bell, 1919), white with blotches brick-red to brown markings, middorsal setae with white tip and base and black at the center and pointing posteriorly, S2 depressed area dorsally black with setae pointing anteriorly, dorso-ventral setae translucent white to pale yellow (Fig. 22c). 3rd: setae are completely lost, head black, body brown and white, S2 with black dorsal triangular patch with 3 lighter colored streaks, S14 with more or less rectangular black dorsal patch, S3–S4 & S11 with large white triangular patch bordered by dark reddish brown, S5–S7 with circular dorsal reddish-brown patch, lighter at center, S8–S9 with white circular dorsal patch mottled with light brown and edged with dark brown, spiracles light blue ringed with black (Figs. 22d–f). 4th: similar to 3rd but larva much broader and flatter and more heavily marked, spiracles light brown (Fig. 22g). 5th: similar to the 4th but dark brown with distinct white patch on S6–S7 extending from dorso-ventral line to subdorsal, spiracles white ringed with black; we have not been able to determine if TOs and a DNO are present (Figs. 22h, i). Pupa: light brown to dark brown to almost black depending on the substrate, heavily blotched with dark colored markings, spiracles white, thorax and abdomen with small dorsal raised projections, shape similar to that of *T. cippus* as described by Bell (1919) (Figs. 22j–l). Pupates on twigs and branches near the base of the larval food plant where it is well-camouflaged (Fig. 22m). Duration of immature stages (days): egg (3–5); 1st instar: (1–2); 2nd (3–6); egg to adult (28–30).

Larval food plant: The current study showed that *Dendrophthoe falcata* (Loranthaceae) is used as a larval food plant in Sri Lanka. The early instar larva feeds only on tender leaves but later instars feed on more mature leaves. Ants have not been observed attending the larvae in the field.

T. jehana ceylanica is found only in the Jaffna peninsula where it is not uncommon. *D. falcata* is widespread in all climatic zones but is particularly common in the dry zone (Dassanayake, 1987). The distribution of the butterfly must be restricted by some factor other than the availability of its larval food plant.

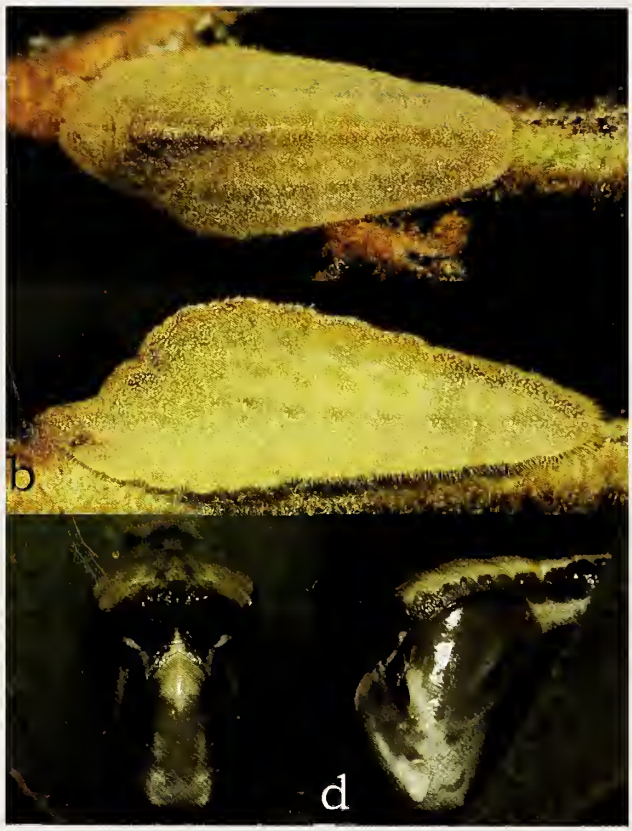

Figure 21. *Pratapa deva deva*. **a**. Larva, final instar, dorsal view. **b**. Larva, final instar, lateral view. **c**. Pupa, dorsal view. **d**. Pupa, lateral view

Tajuria cippus longinus (Fabricius, 1798). Peacock Royal. Endemic subspecies.

The final instar larva and pupa of *T. cippus longinus* in Sri Lanka were described briefly by Moore (1880). In India, the larva and pupa of *T. cippus* (as *T. longinus*) were described by Davidson *et al.* (1896) and Bell (1919). The findings of the current study agree with the descriptions of Moore and Bell (but not that of Davidson *et al.*) except for the following points: a) the larvae in Sri Lanka were exceptionally variable—the ground color ranged from off-white to brown, reddish-brown, and dark chocolate brown, and the markings were variable in placement and color (Figs. 23a–f); b) the pupa fits the description by Bell but is more variable in color, ranging from light grayish-green to brown and reddish-brown (Figs. 23g–j).

Additional notes on immature stages: Egg: dome-shaped and smooth with a slight depression at the top (Fig. 23k). 1st instar: head straw-colored with two black eyespots and red mouthparts, body pale green with an obscure pale yellow dorsal band, S2 depressed dorsally and with brown hexagonal patch. 2nd: not recorded. 3rd: similar to 1st but body darker green (Fig. 23l). 4th: highly variable in color and markings, ground color varies from light green to reddish-brown to dark brown; most individuals with

a dark colored lateral triangular patch from S7–S10 with the broadest side bordering the ventral margin (Figs. 23m–p). Bell (1919) reports the presence of a DNO and TOs but we did not see them. We have never seen the larva with ants though it is common and often seen. Bell (1919) reports that ants hardly ever attend the larva but occasionally 'visit' it. Duration of immature stages (days): pupa (9). One color form is similar to the larva and pupa illustrated by Igarashi & Fukuda (1997) from Hong Kong (subspecies not identified).

Larval food plant: In Sri Lanka, Moore (1880) quoting from Thwaites recorded that it fed on Loranthaceae and Ormiston (1924) recorded that it fed on *Loranthus* [all mistletoe species formerly attributed to the genus *Loranthus* in Sri Lanka have now been transferred to other genera]. The current study showed for the first time that *Dendrophthoe falcata* and *Taxillus cuneatus* (Loranthaceae) are used as larval food plants in Sri Lanka. The first three instars feed on tender leaves while the final two instars feed on more mature leaves. Igarashi & Fukuda (1997) also reported it feeding on Loranthaceae in the Malay Peninsula (subspecies not identified) and Veenakumari *et al.* (1997) reported *T. c. cippus* feeding on Loranthaceae in the Andaman and Nicobar Islands.

T. cippus longinus is widespread below 1000 m asl but is more common in the arid, dry and intermediate zones. *Dendrophthoe falcata* is widespread, but is most common in the dry zone. *Taxillus cuneatus* is more common in the northern areas of the dry and intermediate zone though populations are found in the wet zone near Ratnapura (Dassanayake, 1987). The distribution of these two plants matches the distribution of the butterfly in that at least one of these plants has been found where the butterfly has been recorded but it is possible that other members of the Loranthaceae are also used.

Figure 22. *Tajuria jehana ceylanica*. **a**. Eggs. **b**. Larva, first instar, dorsal view. **c**. Larva, second instar, lateral view. **d**. Larva, third instar, well camouflaged. **e**. Larva, third instar, dorsal view. **f**. Larva, third instar, lateral view. **g**. Larva, fourth instar, dorso-lateral view. **h**. Larva, fifth instar, lateral view. **i**. Larva, fifth instar, dorsal view. **j**. Pupa, dorsal view. **k**. Pupa, dorso-lateral view. **l**. Pupa, dark form, dorsal view. **m**. Pupa, dark form, well camouflaged, dorso-lateral view.

Conclusions

The immature stages of most of the species documented in this study exhibited some variation in size, color and patterning, particularly in the final instar and pupa. They were, however, similar to those described from peninsular India with which Sri Lanka is zoogeographically related, and to those described from other countries in the Indo-Australian region.

The larval food plants used by the Lycaenids dealt with in this paper are mostly similar or the same at least at the family level as those reported elsewhere. Many species reported here are polyphagous, feeding on plants from different families. Several species are monophagous: *Jamides coruscans* and *J. lacteata* (both endemic), *Nacaduba hermus sidoma* and *N. sinhala* (endemic), *Tarucus nara* and *T. callinara*, *Arhopala ormistoni* (endemic) and *A. abseus mackwoodi* (endemic).

Most species were attended by ants only casually: female butterflies oviposited in the field without the presence of ants, and ants were not required for the development of the larva when reared in captivity. Twenty-two species were confirmed to have a DNO and TOs which are ant-associated structures. Only two species are obligate myrmecophiles (*Arhopala centaurus pirama* and *A. a. amantes*), both associating only with *Oecophylla smaragdina*.

Of the species or subspecies dealt with in this paper, 2 are considered Critically endangered (CR) according to IUCN criteria (*Tajuria jehana ceylonica* and *Arhopala ormistoni*); 3 Endangered (EN) (*Pratapa d. deva, Arhopala abseus mackwoodi, Tarucus callinara*) and 3 Vulnerable (VU) (*Nacaduba sinhala, Jamides coruscans* and *J. lacteata*) (van der Poorten, 2012). The information presented in this paper provides some of the base information about the biology of immature stages that is required for conservation work. As well as detailing the larval food plants and ant associations, it also illustrates that the larvae can be successfully raised in the lab should ex-situ conservation measures be needed. More work is required to get a more detailed understanding of the biology of these species in the field.

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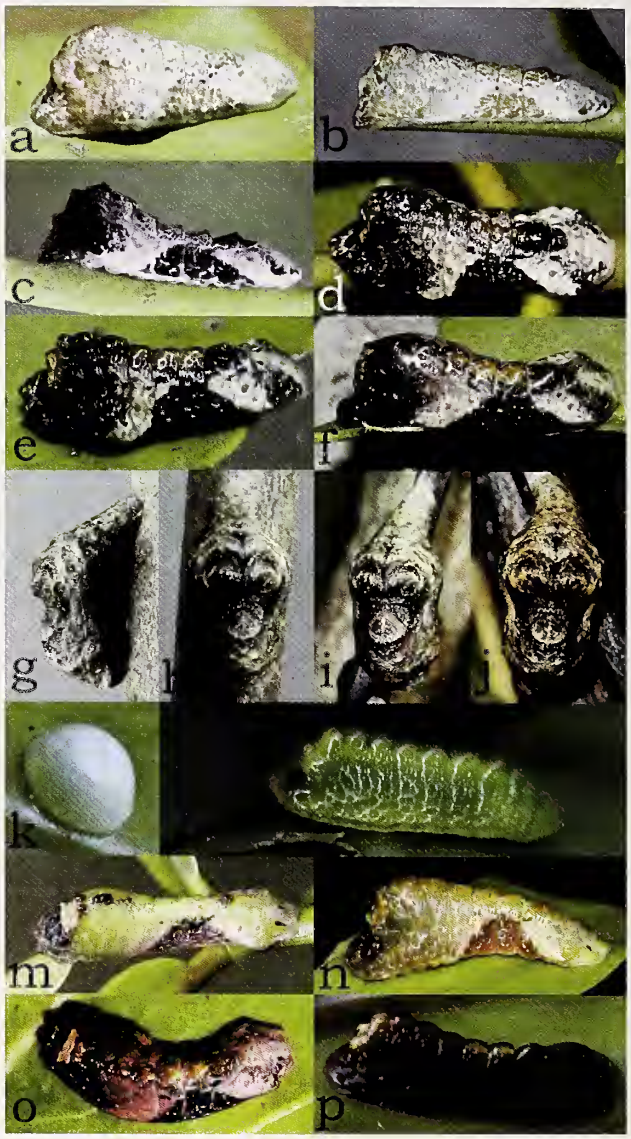

Figure 23. *Tajuria cippus longinus*. **a.** Larva, fifth instar, off-white form, dorso-lateral view. **b.** Larva, fifth instar, off-white form, lateral view. **c.** Larva, fifth instar, light brown form, lateral view. **d.** Larva, fifth instar, reddish-brown form, dorso-lateral view. **e.** Larva, fifth instar, dark brown form, dorso-lateral view. **f.** Larva, fifth instar, dark chocolate brown form, lateral view. **g.** Pupa, light grayish-green form, lateral view. **h.** Pupa, light grayish-green form, dorsal view. **i.** Pupa, brown form with green, dorsal view. **j.** Pupa, reddish-brown form, dorsal view. **k.** Egg. **l.** Larva, third instar, lateral view. **m.** Larva, fourth instar, light green form, dorso-lateral view. **n.** Larva, light greenish-brown form, lateral view. **o.** Larva, light reddish-brown form, dorsal view. **p.** Larva, dark reddish-brown form, dorso-lateral view.

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